North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments Wise County, Virginia

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Response Letters to Public Comments

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North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments Wise County, Virginia

Prepared by:
Virginia Tech Department of Biological Systems Engineering

In cooperation with:
Virginia Department of Environmental Quality
and
Virginia Department of Mines, Minerals, and Energy

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List of Acronyms

AML	Abandoned Mine Land
AVGWLF	ArcView Generalized Watershed Loading Functions
BMP	Best Management Practices
BSE	Biological Systems Engineering
COD	Chemical Oxygen Demand
DCR	Department of Conservation and Recreation
DEQ	Department of Environmental Quality
DGO	Division of Gas & Oil
DMLR	Division of Mine Land Reclamation
DMME	Department of Mines, Minerals, and Energy
DO	Dissolved Oxygen
E&S	Erosion and Sediment Control Program
GIS	Geographic Information Systems
GWLF	Generalized Watershed Loading Functions
HRU	Hydrologic Response Unit
HSPEXP	Expert System for Calibration of HSPF
HSPF	Hydrological Simulation Program - FORTRAN
LA	Load Allocation
MDL	Minimum Detection Limit
MFBI	Modified Family Biotic Index
MOS	Margin of Safety
MPID	Monitoring Point Identification Number
NPDES	National Pollutant Discharge Elimination System
NPS	Non-Point Source
PEC	Probable Effect Concentrations
RBP	Rapid Bioassessment Protocol
RBP II	Rapid Bioassessment Protocol 2
RESAC	Regional Earth Science Application Center
SMC	Unsaturated Soil Moisture Capacity
TAC	Technical Advisory Committee
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorous
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
USLE	Universal Soil Loss Equation
VaSCI	Virginia Stream Condition Index
VBMP	Virginia Base Mapping Project
VDOT	Virginia Department of Transportation
VPDES	Virginia Pollutant Discharge Elimination System
VT	Virginia Tech
WLA	Waste Load Allocation

PREFACE

Virginia's Phased Resource Extraction TMDLs:
North Fork and South Fork Pound River

In order to meet the U. S. Environmental Protection Agency's (EPA) May 1, 2010 deadline, Virginia agencies have been working diligently to complete a Total Maximum Daily Load (TMDL) study for the North Fork and South Fork Pound River. The following draft report represents the product of the state's efforts to date. During development, uncertainties and differences of interpretation regarding report narrative, report format, data, and predictive tools were identified. Assistance with the TMDL was solicited from the U. S. Office of Surface Mining, U. S. EPA, and private contractors. This TMDL was developed with best available data and information to determine pollution load reductions. Additional monitoring is recommended to resolve any uncertainties in pollutant sources. Therefore, the report is being presented as a "phased" TMDL in accordance with EPA guidance and the state will utilize an adaptive management approach.

Phased TMDL

A revised TMDL document will be developed by the Virginia Department of Environmental Quality (DEQ) and the Virginia Department of Mines, Minerals, and Energy's Division of Mined Land Reclamation (DMLR). The revised TMDL is planned for submittal to EPA two years from the date that both the U. S. EPA Region III has approved and the Virginia State Water Control Board (SWCB) has adopted the "phased" North Fork and South Fork Pound River TMDLs. DMLR will take the lead role with the revisions.

Adaptive implementation is an iterative implementation process that moves toward achieving water quality goals while collecting, and using, new data and information. It is intended to provide time to address uncertainties with TMDLs and make necessary revisions while interim water quality improvements are initiated.

A monitoring plan and experimentation for model refinement will be implemented by the Virginia Department of Environmental Quality (DEQ) and DMLR during the period of time beginning with the submittal to EPA of this DRAFT until the preparation of the revised TMDL submittal to EPA.

At a minimum, the plan will include monitoring to accomplish the following:

- Better quantify sediment contributions to the watershed from active mining operations during larger storm events and,
- To better quantify groundwater and interflow contributions to the wasteload allocations identified in the report.

<u>Interim Actions</u>

The follow interim actions will be implemented immediately upon both the approval of the TMDL by EPA and adoption of the TMDL by the SWCB:

DMLR will utilize its existing TMDL processes and software to maintain or decrease existing pollution wasteloads from active mining for sediment (TSS) and total dissolved solids (TDS). DMLR will also restrict and minimize impacts of additional mining, through the use of offset requirements, to collective pollution loads equal to or below current wasteloads.

All Waste Load Allocations in this TMDL will be effective and implemented by DMLR. EPA regulations require that an approvable TMDL include individual WLAs for each point source. According to 40 CFR '122.44(d)(1)(vii)(B), Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, shall be consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR '130.7." DEQ will permit non-coal dischargers in compliance with wasteload allocations included in the TMDL and the agencies' current policies and procedures.

It is DMME's intention to gather additional monitoring data, conduct modeling refinements and revise this TMDL if warranted within two years of approval of this TMDL. Therefore, DMME recommends that the waste load allocations for active mining in this TMDL be implemented in a staged approach. On-going, long-term efforts to improve the watershed as described below will continue.

- The elimination or reduction of pollution loads from abandoned coal mined lands (AML) is typically necessary for the state to meet the allocations prescribed in Virginia's resource extraction TMDLs. DMLR's efforts to eliminate and reduce pollution from AML will continue in the TMDL watershed.

- DMLR will utilize AML Program Funding, including the U. S. Office of Surface Mining's annual AML grants, Clean Streams Initiative, and Acid Mine Drainage set-aside provisions, to remediate AML problems within the watersheds.

- DMLR recognizes that assistance is needed with AML reclamation and will encourage assistance from Virginia's active coal mining industry. Several approaches, consistent with this recognition, will be implemented including re-mining, Rahall permits, AML enhancements, and TMDL offsets.

- TMDL offsets will provide for mine discharge permit applicants to reclaim existing AML features within the watershed to create a water pollution offset for proposed coal mining activities. The offsets will be required to contain a positive ratio for pollution reduction and to eliminate permanent pollutant sources for temporary pollution credit.

- The Federal effluent guidelines for the coal mining point source category (40 CFR Part 434) provide various alternative limitations for discharges caused by precipitation. Under those technology-based guidelines, effluent limitations for TSS may be replaced with an alternative limitation for settleable solids during certain magnitude precipitation events that vary by mining subcategory. The water quality-based WLAs in this TMDL report preclude the applicability of the *alternative precipitation* provisions of 40 CFR Part 434. During the 2-yr phased TMDL, efforts will be made to perform TSS monitoring during the full range of storm events occurring in that time perod. This will improve the assessment of sediment loads from active mining areas.

Please note that sections of the draft TMDL report, *North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments, Wise County, Virginia*, have been revised. Refer to the attached amendment which provides the revised contents of the TMDL document. The TMDL allocations and the methods used to compute the TMDL allocations presented in the attachment will supersede those that are presented in the draft report. Written public comments received on the amendment to the report are attached and will be considered and addressed during the second phase of TMDL development.

EXECUTIVE SUMMARY

Background

The purpose of this report is to describe the Total Maximum Daily Loads (TMDLs) developed to address the benthic impairments on three impaired stream segments: the Lower North Fork Pound River (VAS-Q13R-02), the South Fork Pound River (VAS-Q13R-01), and Phillips Creek (VAS-Q13R-04), a tributary to the South Fork Pound River. A part of the Big Sandy River basin, the North Fork and South Fork Pound River watersheds comprise the upstream portion of state hydrologic unit Q13 (the complete National Watershed Boundary Dataset watershed BS28), and are located south and west of the Town of Pound in Wise County, Virginia, as shown in Figure ES-1.

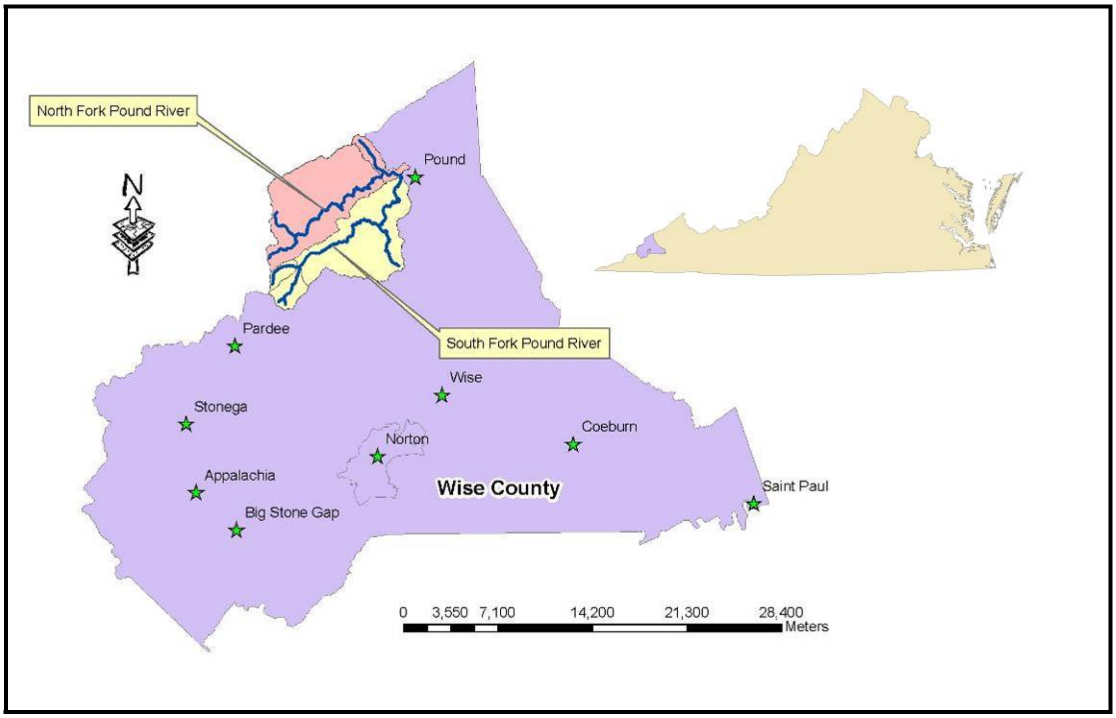

Figure ES- 1. North Fork and South Fork Pound River Watersheds

The combined watersheds are 23,364 acres (9,455 ha) in size. The main land use category in the combined watersheds is forest, 68%. The remaining watershed area includes mining-related (23%), agriculture (5%), and urban/residential land uses (4%). The North and South Forks of Pound River flow into the Pound River which flows northeasterly into Russell Fork, which flows northwesterly into Kentucky, where it enters the Levisa Fork. Levisa Fork flows into the Big Sandy River, which then flows into the Ohio River, then into the Mississippi River, and on to the Gulf of Mexico.

Aquatic Life Use Impairment

The South Fork Pound River (VAS-Q13R-01) was originally listed as impaired on Virginia's 1994 Section 303(d) Total Maximum Daily Load Priority List and Report due to water quality violations of the general aquatic life use (benthic) standard. In 1996, a segment of the North Fork Pound River below North Fork Pound Lake (VAS-Q13R-02) was also added. As a result, the Environmental Protection Agency (EPA) added these segments to a 1998 consent order requiring TMDLs by 2008. Since then, two headwater tributaries to the South Fork Pound River – Donald Branch and Phillips Creek – were added to the 305(b) list in 2002 as one segment (VAS-Q13R-04).

The benthic impairment in the Lower North Fork Pound River (VAS-Q13R-02) was based on Virginia Department of Environmental Quality (DEQ) biological monitoring station PNK000.08; the impairment in the South Fork Pound River (VAS-Q13R-01) based on monitoring station PNS000.40; and the impairment in Phillips Creek (VAS-Q13R-04) was based on monitoring station PNS008.73.

DEQ delineated the benthic impairment as 8.61 miles on the South Fork Pound River (stream segment VAS-Q13R-01); 1.11 miles on the North Fork Pound River (VAS-Q13R-02); and 1.87 and 2.14 miles, respectively, on Donald Branch and Phillips Creek (VAS-Q13R-04). The impaired Donald Branch and Phillips Creek extend from their headwaters to their confluence – the beginning of the South Fork Pound River. The impaired stream segment on the South Fork Pound River includes the entire main stem from the confluence of the two impaired headwater segments and extends to the confluence of the North and South Forks of Pound River. The impaired segment on the North Fork Pound River extends from the North Fork Pound Lake dam downstream to its confluence with the South Fork Pound River. Because of pre-law mining modifications, Donald Branch no longer exists as a surface feature. Therefore, while the Donald Branch sub-watershed will be subject to reductions called for to address the downstream impaired segment on South Fork Pound River, a separate TMDL will not be developed for Donald Branch. The impaired segments in the North Fork and South Fork Pound River are shown in Figure ES- 2 .

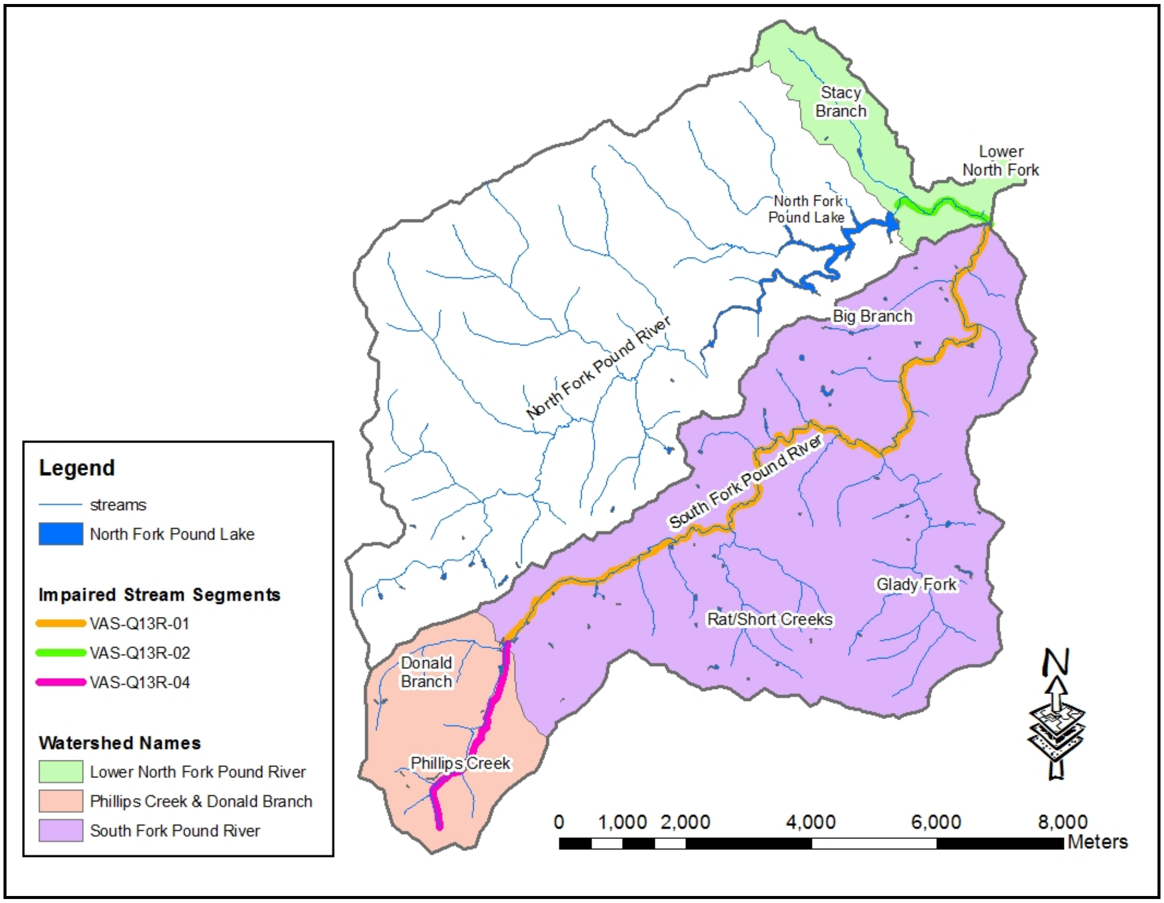

Figure ES- 2. Impaired Segments on North Fork and South Fork Pound River

Benthic Stressor Analysis

TMDLs must be developed for a specific pollutant. Since a benthic impairment is based on an assessment of the stream's biological community, rather than on a physical or chemical water quality parameter, the pollutant is not explicitly identified, as is the case with physical and chemical parameter-based impairments. The process outlined in EPA's Stressor Identification Guidance Document (USEPA, 2000) was used to identify the critical stressor for the impaired segments in the North Fork and South Fork Pound River watersheds.

A list of candidate causes (stressors) was developed from the impairment listing information, biological data, published literature, and stakeholder input.

Chemical and physical monitoring data collected through DEQ monitoring provided additional evidence to support or eliminate potential stressors. While biological metrics and habitat evaluations in aggregate provided the basis for the initial impairment listing, individual metrics were used to assess links with specific stressors, where possible. Volunteer monitoring data, land use distribution, Virginia Base Mapping Project (VBMP) aerial imagery, and visual assessment of conditions in and along the stream corridor provided additional information to investigate potential stressors. Logical pathways linking stressors with observed effects in the impaired benthic communities were explored. The following potential stressors were examined: ammonia, hydrologic modifications, nutrients, organic matter, pH, sediment, total dissolved solids (TDS) and related parameters – conductivity and sulfates, temperature, and toxics. The stressor analysis discussion that follows was adapted from the North Fork and South Fork Pound River Stressor Analysis Report (Yagow et al., 2007).

The benthic impairment on the Lower North Fork Pound River (VAS-Q13R-02) is relatively minor, with individual Virginia Stream Condition Index (VaSCI) sample scores varying between 35.0 and 65.9, with an average of 55.4 for samples in 2006 (scores >60 indicate non-impairment). The Lower North Fork Pound River segment is located downstream from the North Fork Pound Lake. The lake appears to serve as a sink for pollutants from upstream sources and as a minor source of sediment. Ambient water quality data for this segment is only available for 2006-07, and there is a 6-yr gap in the biological data. Sediment contributions from Stacy Branch, a major tributary to this impaired segment, were thought to be possible but unknown until recent monitoring indicated sediment concentrations similar to other parts of the watershed. The Lower North Fork Pound impaired segment is poorly buffered with alkalinity measurements below 20 mg/L, but does not appear to have any immediate threats from sources of acidity. Excess sediment was determined to be the most probable stressor based on the repeated poor scores for sediment metrics in the habitat assessments.

The benthic impairment on the South Fork Pound River (VAS-Q13R-01) was based on consistently low values of the VaSCI with a 2006 average of 33.1.

Extensive mining has impacted this watershed. While the three biological monitoring sites along the South Fork Pound River have more ambient water quality data than those in the North Fork Pound River watershed, there is a 26-yr gap in ambient data between 1980 and 2006, followed by only occasional biological samples collected between 2000 and 2006. Although samples from these stations vary in time, the middle station is characterized by slightly better habitat and benthic community metrics than the upstream and downstream monitoring stations. While total phosphorus (TP) concentrations are near detection limits, nitrogen concentrations have increased over time. The source of nitrogen is unknown, but does not appear to be the major stressor. High total suspended solids (TSS) concentrations detected by monitoring from the Virginia Department of Mines, Minerals, and Energy's Division of Mine Land Reclamation (DMLR) and poor habitat metrics led to the determination that excess sediment is a probable stressor for the South Fork Pound segment. Additionally, widespread elevated levels of TDS and its related constituents – conductivity and sulfate – also led to TDS being included as a probable stressor. As such, a TMDL was developed for the TDS stressor.

The benthic impairment on Phillips Creek (VAS-Q13R-04) is quite severe with a 3-sample VaSCI average score of 15.1. The hydrology in the Phillips Creek watershed has been radically altered through extensive mining and reclamation. Almost the entire watershed is included in various mining permits. Extensive mining in the headwaters has resulted in the elimination of all lotic aquatic habitat in this watershed which also affects downstream propagation of these organisms. No DEQ ambient water quality data is available for this watershed, and a 7-yr gap exists between the first and the last two biological samples. All DMLR measurements of TDS and related parameters within this watershed have been extremely high. Though direct measurements of sediment loads were not available in the watershed, the large amount of disturbed land in the watershed from forest harvesting, surface mining, abandoned mine land (AML), and re-shaping of the landscape all point to sediment as a stressor in this and downstream impaired stream segments. Hydrologic modifications, sediment, and TDS, therefore, have been selected as the most probable stressors for Phillips Creek.

New Changes to the North Fork and South Fork Pound River TMDLs

Changes to the North Fork and South Fork Pound River sediment and TDS TMDLs since the last Public Meeting on September 25, 2008 include:

- TMDLS were designated as "phased" TMDLs, due to uncertainties in pollutant load distribution among identified sources.
- Correction to the classification of the "barren" land use as a non-mining land use, as originally intended.
- Sediment TMDL
    - Used "existing" loads as the basis for reductions, rather than "future" loads that assumed unlimited disturbed areas within each mining permit.
    - Changed simulation period to 1995-2007, which corresponds with the period after which DMLR began electronic record keeping. Previously, the simulation period was 1985-2003.
    - Calibrated the GWLF model using DMLR observed flow and TSS data to ensure closer comparability with DMLR accounting procedures for regulated permit waste loads.
- TDS TMDL
    - Separated background loads arising from interflow for non-mining land uses from permitted mining waste loads.

Sediment TMDL Development

Sources of Sediment

Sediment is generated in the Lower North Fork and South Fork Pound River watersheds through the processes of surface runoff, in-channel disturbances, and streambank and channel erosion, as well as from background geologic forces. Sediment generation is accelerated through human-induced land-disturbing activities related to a variety of agricultural, forestry, mining, transportation, and residential land uses.

Modeling

A sediment TMDL was developed for each of the three impaired segments. The sediment TMDLs were developed using a "reference watershed" approach, because Virginia has no numeric in-stream criteria for sediment. The reference watershed approach uses one watershed whose streams are supportive of their designated uses (the reference watershed) to set the target TMDL load for the watershed whose streams are impaired (the TMDL watershed). Burns Creek in Wise County (6ABUC000.24) was selected as the TMDL reference watershed for the Lower North Fork Pound River. Upper Dismal Creek in Buchanan County (6ADIS017.94) was selected as the TMDL reference watershed for the nested Phillips Creek and the South Fork Pound River watersheds.

The Generalized Watershed Loading Function (GWLF) model (Haith et al., 1992) was selected for comparative modeling for the sediment TMDL study. All parameters were initially evaluated in a consistent manner between the reference and impaired watersheds, in order to ensure their comparability for the reference watershed approach. All GWLF parameter values were evaluated from a combination of GWLF user manual guidance (Haith et al., 1992), AVGWLF procedures (Evans et al., 2001), procedures developed during the 2002 statewide NPS pollution assessment (Yagow et al., 2002), and best professional judgment. Parameters for active mining and AML land uses were evaluated from available literature sources.

Historically in Virginia, the GWLF model has been used in a variety of TMDLs to address sediment as a stressor in streams with benthic impairments. In these previous TMDLs, sediment has only been subject to accounting and reductions from non-permitted sources, and the successful restoration of the impaired stream was to be judged solely by the recovery of the benthic macro-invertebrate population and associated metrics, not by measured in-stream sediment. This is clearly not the case in the North Fork and South Fork Pound River, where permitted waste load allocations for sediment are closely monitored and tracked by DMLR, and will serve as the basis for determining existing waste load allocations for new mining permits. Although GWLF was originally developed for use in non-gaged watersheds and, therefore, did not require calibration, calibration was performed for flow and sediment at two points in the South Fork Pound River watershed and at one point in the Upper Dismal Creek reference watershed, in order to obtain a greater correlation with available observed data, and to achieve a greater degree of consistency with DMLR's tracking software for Waste Load Allocations. The calibration adjustments in South Fork Pound River were applied to the Lower North Fork Pound River and the Burns Creek reference watershed, since observed data were not available for independent calibrations.

Calibration endpoints were set as unit-area TSS load measures developed using the observed data at available DMLR monitoring stations in both the reference and TMDL watershed. Unit-area measures allow for comparison between watersheds of different sizes. The GWLF model was calibrated for both hydrology and sediment, using sub-watersheds defined by DMLR MPIDs 3420110 and 0004381 in South Fork Pound River and by MPID 0004569 in Upper Dismal Creek. The hydrology parameters adjusted during calibration included: monthly evapotranspiration (ET) coefficients, the seepage coefficient, and the curve number by landuse. The sediment parameters adjusted during calibration included: sediment pond efficiency by calibration sub-watershed, and the curve number by landuse. The simulated unit-area output for both flow and sediment (TSS) from calibration sub-watersheds above MPIDs 3420110 and 0004569, respectively for the Phillips Creek and Upper Dismal Creek watershed models, were each within 2% of their respective observed median or average values. Although a larger percentage difference existed between observed and simulated values for the calibration sub-watershed for the South Fork Pound River (MPID 0004381), both of the South Fork Pound River unit-area measures were considerably different from the other two watersheds. Since significant model parameter calibration adjustments had already been made which resulted in the simulated loads being reduced by nearly two orders of magnitude, and since the observed data was limited, the small remaining numeric differences between the observed and simulated median TSS unit-area loads in South Fork Pound River were considered acceptable for the calibration. Overall, the calibrated models provide reasonable agreement between the simulated and observed results, given the short period of record of observed and the limited range of observed flow conditions. Additional refinements are anticipated during the second phase on the TMDL, when additional monitoring data are available for calibration. These calibration adjustments were then applied to models of the full South Fork Pound River, Upper Dismal Creek, Lower North Fork Pound River, and Burns Creek watersheds and model simulations run for the 1995-2007 period.

The combined Lower North Fork and South Fork Pound River watersheds were sub-divided into 23 sub-watersheds to facilitate modeling sediment loads to the three impaired segments. For TMDL modeling, a common weather input data set was used for the 13-yr period, January 1995 – December 2007. The existing sediment loads (both point and nonpoint sources) were modeled and averaged over a 13-year period to take into account both wet and dry periods in the hydrologic cycle. In addition, model inputs took into consideration seasonal variations and critical conditions related to sediment loading. Table ES-1 reports the average annual sediment load (metric tons per year, t/yr), and unit-area sediment loads (metric tons per hectare, t/ha) by source category for watersheds corresponding to each of the three impaired segments and their corresponding area-adjusted reference watershed.

Table ES- 1. Existing sediment loads (t/yr) and unit-area sediment loads (t/ha) in North Fork and South Fork Pound River watersheds and corresponding area-adjusted Reference Watersheds

Modeled Land Use Categories	Lower North Fork (LNF) Pound River		LNF Area-adjusted Burns Creek		Phillips Creek (PC)		PC Area-adjusted Upper Dismal Creek		South Fork (SF) Pound River**		SF Area-adjusted Upper Dismal Creek	
	(t/yr)	(t/ha)	(t/yr)	(t/ha)	(t/yr)	(t/ha)	(t/yr)	(t/ha)	(t/yr)	(t/ha)	(t/yr)	(t/ha)
Cropland			0.9	1.4	0.5	5.4	0.2	3.7	37.3	1.9	1.3	2.8
Pasture	3.7	0.2	0.3	0.1	0.3	0.4	1.7	0.2	46.7	0.2	11.4	0.2
Hay	0.3	0.1	0.2	0.2	0.0	0.2			4.2	0.1		
Forest	52.6	0.1	53.5	0.1	52.1	0.2	72.4	0.2	315.4	0.1	494.4	0.1
Barren	263.1	12.6	304.7	4.5	165.0	15.9	54.2	13.5	2,125.0	10.3	370.4	10.2
Mining												
Extractive	11.9	38.4			222.4	1.6	4.2	6.7	1,270.1	2.0	28.9	5.1
Reclaimed					2.4	0.2	0.3	0.6	27.1	0.2	1.9	0.5
Released					2.2	1.8	0.8	1.7	12.9	1.3	5.4	1.3
AML					77.4	18.2	390.3	16.2	4,011.9	13.2	2,666.1	12.3
Low Density Residential	0.7	0.1	0.2	0.1			1.3	0.1	1.3	0.1	9.0	0.1
Medium Density Residential	0.3	0.1		0.1			0.0	0.1	0.0	0.0	0.0	0.1
High Density Residential	1.1	0.1	0.0	0.0			0.1	0.1	1.2	0.1	1.1	0.1
Transportation	0.6	0.1		0.1			0.4	0.1	0.5	0.1	3.0	0.1
Channel Erosion	2.1		0.2		0.1		0.6		0.5		28.3	
Outflow from Dam	344.5											
Total Load	**680.8**		**359.9**		**522.5**		**526.4**		**7,854.1**		**3,621.1**	

Phased Sediment TMDLs

The phased sediment TMDL for each impaired segment in the North Fork and South Fork Pound River was calculated using the following equation:

$$TMDL = \sum WLA + \sum LA + MOS$$

where $\sum$WLA = sum of the wasteload (permitted) allocations;

$\sum$LA = sum of load (nonpoint source) allocations; and

MOS = margin of safety (explicit, 10% of TMDL).

The TMDL and its three required components – WLA, LA, and MOS - are quantified in Table ES-2.

Table ES- 2. North Fork and South Fork Pound River Phased Sediment TMDLs (t/yr)

Allocations can be found in the amendment attached to the end of this document:
Amendment to the TMDL document, titled *North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments Wise County, Virginia*
(Initially submitted to VADEQ April 2010)

The TMDL sediment load for the Lower North Fork Pound River watershed was defined as the average annual sediment load (t/yr) from the area-adjusted Burns Creek watershed (from Table ES-1), while the TMDL sediment loads for each of the nested watersheds in the South Fork Pound River was defined as the average annual load from the Upper Dismal Creek watershed (from Table ES-1), area-adjusted to each of the nested watersheds. The waste load allocation (WLA) was calculated as the permitted loads from all point source and stormwater permitted facilities corresponding to each of the three impaired segments, with allowances provided for future growth. Since the existing WLA in the Lower North Fork Pound River was relatively minor, an additional allowance of 1% of the TMDL was included in the WLA for unspecified future growth. The margin of safety (MOS) was explicitly specified as 10% of the calculated TMDL. The load allocation (LA) – the allowable sediment load from nonpoint sources – was calculated as the TMDL minus the MOS minus the WLA.

Sediment TMDL Reductions and Allocations

For development of the allocation scenarios, permitted WLA loads for mining and gas and oil well construction were separated from other mining area sediment loads that are not subject to regulation, termed "stormwater" in Table ES- 3. Also for these scenarios, pasture, hay, and urban grass were grouped into the "pasture/hay" category; and all residential and transportation sources were grouped together as "residential/urban". Three alternative allocation scenarios were developed for each impaired segment, as shown in Tables ES-4, ES-5, and ES-6, respectively for Lower North Fork Pound River, Phillips Creek, and South Fork Pound River.

In the Lower North Fork Pound River, TMDL Alternative 1 represents equal % reductions from all source categories. TMDL Alternative 2 requires equal % reductions from all sources except from outflow from the dam, which shows that the TMDL cannot be met without some reductions from outflow from the dam. TMDL Alternative 3 divides the percent reduction equally between the two largest load categories – barren and outflow from the dam.

Table ES- 3. Phased Sediment TMDL Load Allocation Scenarios for Lower North Fork Pound River

Allocations can be found in the amendment attached to the end of this document: Amendment to the TMDL document, titled *North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments Wise County, Virginia* (Initially submitted to VADEQ April 2010)

The Lower North Fork Pound River sediment TMDL is 359.9 t/yr, with a modeling target equal to the TMDL minus the MOS (359.9 – 36.0 = 323.9 t/yr), requiring an overall reduction of 52.4% from the existing conditions scenario. In the Lower North Fork Pound River, TMDL Alternative 1 represents equal % reductions from all source categories. TMDL Alternative 2 requires equal % reductions from all sources except from outflow from the dam, while TMDL Alternative 3 represents taking the reduction from the two largest load categories – barren or transitional land uses and outflow from the dam. Of the three alternative allocation scenarios explored, TMDL Alternative 3 is recommended as the starting point for consideration by a local watershed steering committee during the implementation phase. Barren land uses result from construction of access roads and drilling sites for gas and oil wells, logging, and from residential activities.

Table ES- 4. Phased Sediment TMDL Load Allocation Scenarios for Phillips Creek

Allocations can be found in the amendment attached to the end of this document: Amendment to the TMDL document, titled *North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments Wise County, Virginia* (Initially submitted to VADEQ April 2010)

The Phillips Creek sediment TMDL is 526.4 t/yr, with a modeling target equal to the TMDL minus the MOS (526.4 – 52.6 = 473.8 t/yr), requiring an overall reduction of 9.3% from existing loads. In Phillips Creek, TMDL Alternative 1 represents equal % reductions from all significant source categories. TMDL Alternative 2 requires taking equal % reductions from the two largest non-permitted sources, while Alternative 3 first reduces AML and takes the remaining reduction from barren areas. Of the three alternative allocation scenarios explored, TMDL Alternative 3 is recommended as the starting point for consideration by a local watershed steering committee during the implementation phase. Barren land uses result from construction of access roads and drilling sites for gas and oil wells, logging, and from residential activities.

Table ES- 5. Phased Sediment TMDL Load Allocation Scenarios for South Fork Pound River

Allocations can be found in the amendment attached to the end of this document: Amendment to the TMDL document, titled *North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments Wise County, Virginia* (Initially submitted to VADEQ April 2010)

The South Fork Pound River sediment TMDL for the watershed is 3,621.1 t/yr, with a modeling target equal to the TMDL minus the MOS (3,621.1 - 362.1 = 3,259.0 t/yr), requiring an overall reduction of 58.5% from existing loads. In the South Fork Pound River, all TMDL alternatives account for upstream allocations for the Phillips Creek TMDL and call for 100% reduction from AML and 0% reduction from permitted sources. TMDL Alternative 1 represents equal % reductions from all other source categories; TMDL Alternative 2 calls for equal % reductions from the three major sources in addition to AML; and TMDL Alternative 3 takes reductions only from the barren category in addition to AML. Of the three alternative allocation scenarios explored, TMDL Alternative 3 is recommended as the starting point for consideration by a local watershed steering committee during the implementation phase.

In the Lower North Fork Pound River watershed, barren areas along the riparian corridor and outflow from the dam appear to be the primary sources of sediment in the minor impairment of this stream segment. In the Phillips Creek and South Fork Pound River watersheds, AML and barren land uses are the primary sources of sediment. AML reclamation and improved erosion control management and minimization of disturbed area footprints are recommended as the primary targets of implementation efforts. Barren land uses result from construction of access roads and drilling sites for gas and oil wells, logging, and from residential activities. The sediment TMDLs for Lower North Fork Pound

River, Phillips Creek, and South Fork Pound River are being developed as phased TMDLs because of uncertainties in contributions of simulated loads from various land uses, including permitted sources. Additional monitoring will be conducted during the 2-year phased TMDL period, including TSS monitoring during storms currently allowed to meet an alternate standard for settleable solids. The monitoring will be used to evaluate the effectiveness of sediment ponds and sediment loading from AML, barren, and permitted mining areas. At the conclusion of the 2-year phased TMDL period, TMDL modeling will be revised based on the additional monitoring data.

Components of the Phased Sediment TMDL

The sediment TMDLs for the North Fork and South Fork Pound River are being developed as phased TMDLs because of uncertainties in contributions of simulated loads from various land uses, including permitted sources. Additional monitoring will be conducted during the 2-year phased TMDL period, including TSS monitoring during storms currently allowed to meet an alternate standard for settleable solids. At the conclusion of the 2-year phased TMDL period, TMDL modeling will be revised based on the additional monitoring data.

Modeling of the North Fork and South Fork Pound River watersheds produced monthly flow volumes and total suspended sediment (TSS) loads, with major contributions from abandoned mine land (AML) and barren areas. This modeling relied on land use-based parameters that governed surface runoff and erodibility, with limited data available in the literature to evaluate and differentiate between active these two major sediment sources. Furthermore, the trapping efficiencies of sediment ponds are highly variable, and sufficient data were not available in the North Fork and South Fork Pound River watersheds to evaluate site specific values, leading to the use of debatable values arrived at through calibration. In addition, the limited TSS data available in North Fork and at the calibration stations on the South Fork Pound River had a limited range of rainfall-runoff response, making it difficult to judge the reasonableness of modeled load estimates and of relative loads from various mining sources.

The North Fork and South Fork Pound River Phased TMDLs for sediment will be developed in accordance with EPA's 2006 Guidance on Phased TMDL and will include the following components:

1. The TSS load from permitted mining areas will be calculated from the maximum daily TSS permit criterion of 70 mg/L and the simulated average annual surface runoff volume from extractive areas for all storms, and will comprise the permitted mining component of the WLA.
2. Consistent with current permit conditions, no additional reductions will be required from permitted mining sites below a maximum daily TSS concentration of 70 mg/L, pending further data collection and analysis during the next phase.
3. To address the TSS data deficiency for storm events, TSS monitoring during the 2-yr phased TMDL will be performed during the full range of storm events occurring below the 10-yr, 24-hr design storm. This will improve the assessment of sediment loads from active mining areas.

DMME's March 30, 2009 Memorandum will assist the phased TMDL monitoring effort, by requiring additional TSS sampling for all National Pollutant Discharge Elimination System (NPDES) discharges in TMDL watersheds where TSS is a stressor and in impaired watersheds where resource extraction is listed as causing the impairment. It is important that TSS monitoring be performed because TSS loads are not currently tracked when alternate effluent limits are utilized.

<u>Total Dissolved Solids (TDS) TMDL Development</u>

Sources of TDS

The TDS impairment only occurred in the two South Fork Pound River impaired stream segments, where TDS loads are transported through surface runoff, interflow, groundwater, and direct mine discharges. The majority of TDS appears to be related to a mixture of current and historical mining activities, together with background groundwater loads. TDS are coming from both active and abandoned mining areas during surface runoff events, and in-between storms through loading from interflow, groundwater, and pre-law mine discharges. Residential TDS sources within the watershed include failing septic systems and straight pipes. Road salt application is another source of TDS within the watershed during the winter. In addition, TDS is also present from natural geologic sources in both the impaired and reference watersheds.

Modeling

A TDS TMDL was developed for each of the two impaired segments in the South Fork Pound River. The TDS TMDL to address the benthic impairment in each impaired segment was developed using a "reference watershed" approach, because Virginia has no numeric in-stream criteria for TDS. Concentration was determined to be the appropriate type of endpoint in determining the TDS TMDL for the South Fork Pound River impaired stream segments.

The model selected for development of the TDS TMDL was the Hydrological Simulation Program – FORTRAN (HSPF) model, version 12 (Bicknell et al., 2001; Duda et al., 2001). Model development for the South Fork Pound River watersheds was performed by assessing the sources of TDS in the watershed, evaluating the necessary parameters for modeling, calibrating to observed data, and running the model to simulate in-stream TDS concentrations and loads. Sources of TDS accounted for in the model include surface disturbances related to mining activities (extractive, AML, reclaimed, and released land uses), pre-law mine discharges, road salt runoff, and failing septic systems and straight pipes. TDS was simulated as a conservative pollutant with load contributed from the various sources through surface runoff, interflow, groundwater, and direct mine discharges. TDS parameter values in the model were initially estimated and then adjusted to match observed in-stream concentrations through calibration.

Because no continuous hydrology gauge is available on the South Fork Pound River, a detailed hydrology calibration was performed for nearby Cranes Nest River, and the calibration adjustments transferred to the South Fork Pound River watershed. The results were then visually compared to the available

DMLR-monitored flow data available for the South Fork Pound River at multiple points and additional parameter adjustments were made to fine-tune the calibration. A comparison between observed and simulated concentrations at one of these calibration points is shown in Figure ES- 3.

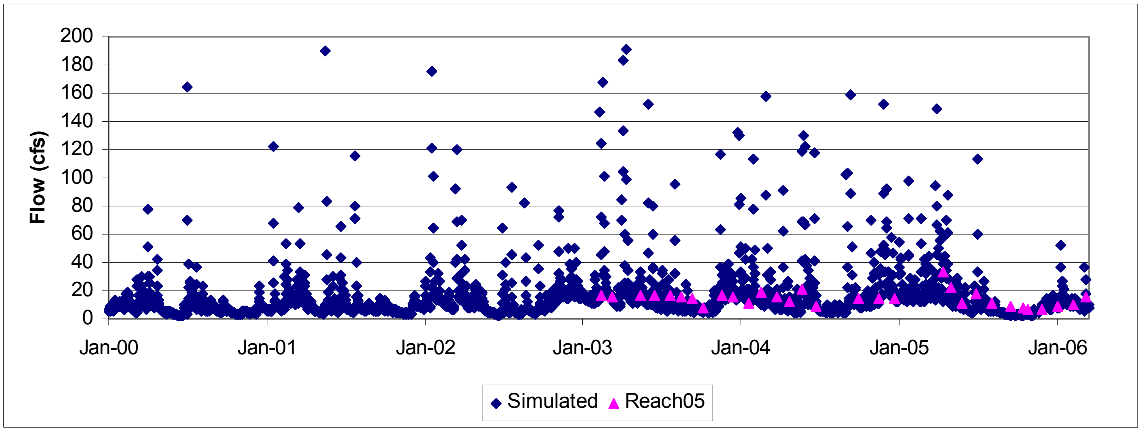

Figure ES- 3. Calibrated Simulated vs. Observed Flow in South Fork Pound River Reach 5

Parameters for active mining and AML land uses were initially evaluated from available literature sources, but only limited information was available to differentiate between these sources. Because of the uncertainties in the exact distribution of these loads, phased TMDLs were determined to be appropriate for the TDS stressor in the two impaired segments of South Fork Pound River.

Although the distributions among the various pathways of surface transport, interflow, and groundwater contributions to stream loads and between permitted mining and AML sources are somewhat uncertain, the total TDS loads from the watershed appear reasonable in relation to observed in-stream concentrations, and loads from the other sources of TDS - residential, road salt, and pre-law mining - have been estimated with a degree of confidence. To calculate TDS loads generated for each mining permit, the model was first run with loads calculated from individual sub-watersheds with TDS sources from AML, road salt, pre-law mine discharges and residential septic sources turned off. Individual WLAs for each mining permit were based on the proportionate area of each permit within each of the 19 modeling sub-watersheds multiplied times the

TDS load from permitted mining sources in each sub-watershed. The watershed load for each permit was then calculated by summing all sub-watershed loads from that permit.

During TDS calibration, parameters values for each calibration sub-watershed were adjusted until simulated in-stream mean daily TDS concentrations and patterns agreed with available instantaneous DMLR TDS data collected in South Fork Pound River for the January 2000 – January 2006 period. Observed in-stream TDS concentrations from DMLR monitoring were available at multiple points within the South Fork Pound River. The same seven monitoring points used for hydrologic calibration were used for TDS calibration in the South Fork Pound River.

Inputs for TDS loads from road salt applications, failing septic systems, straight pipes and pre-law mine discharges were quantified, and were not adjusted during calibration. Calibration focused on parameters affecting the largest components of the TDS loads that were less certain: surface runoff, interflow, and groundwater. A multi-point calibration was performed by adjusting appropriate parameter values starting with upstream sub-watersheds and working progressively downstream. One comparison of the calibrated model simulation TDS concentrations and observed TDS concentrations are shown in Figure ES- 4 for one reach near the outlet of the South Fork Pound River.

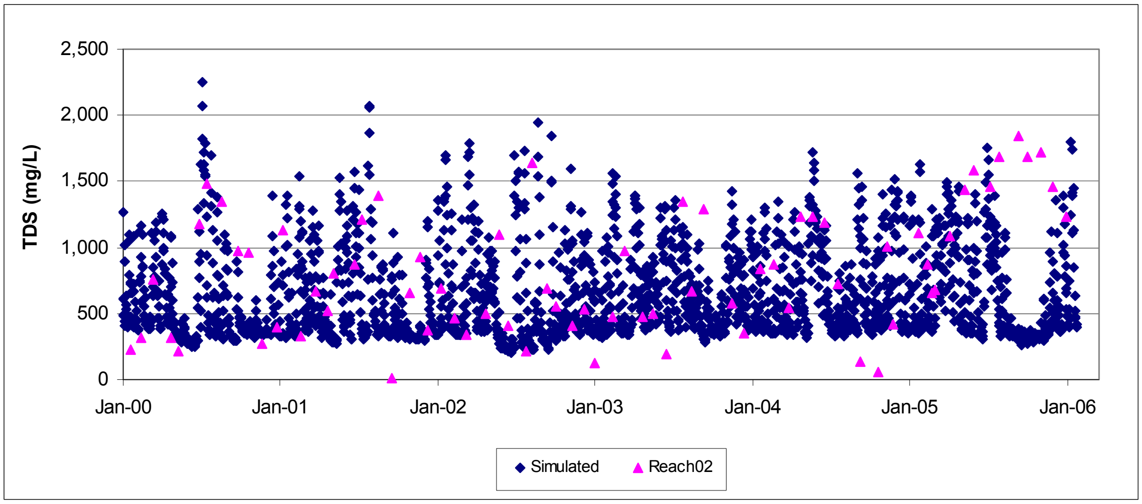

Figure ES- 4. Calibrated Simulated vs. Observed TDS Concentrations in South Fork Pound River Reach 2

A visual comparison of simulated and observed in-stream TDS concentrations and best professional judgment were used to assess when a reasonable model calibration had been achieved. Additionally, the range and average of TDS concentrations were considered during calibration. Taken together, the visual data comparison and the descriptive statistics were evidence of a reasonable calibration of this highly variable parameter.

Average annual TDS loads were simulated using the calibrated model for the existing conditions in the Phillips Creek and South Fork Pound River watersheds, and are listed by source category and average annual load (kg/yr) in Table ES-7. A 6.08-year period (January 2000 – January 2006) was simulated to take into account both wet and dry periods in the hydrologic cycle, and to include seasonal variations and critical conditions related to sediment loading.

Table ES- 6. Sources of Existing TDS Loads in Phillips Creek and South Fork Pound River (kg/yr)

TDS Sources	Phillips Creek (kg/yr)	SF Pound River* (kg/yr)
Permitted Mining	1,512,101	8,552,267
Pre-law mine discharge	25,371	60,494
AML	26,268	1,021,794
Background	41,791	402,806
Road salt	556	69,751
Residential	224	10,471
Total	**1,606,310**	**10,117,581**
* Includes Phillips Creek		

TDS TMDL Endpoint

The TDS concentration endpoint for TMDLs in both Phillips Creek and the South Fork Pound River was 369 mg/L, the 90th percentile of DEQ-monitored TDS concentrations from Lower Dismal Creek at DEQ monitoring station 6ADIS001.24, located in Buchanan County.

TDS Allocation Scenarios

The TDS concentration endpoints for Phillips Creek and the South Fork Pound River were achieved by making incremental reductions from various anthropogenic sources of TDS and then simulating the corresponding TDS concentrations and loads. Residential sources of TDS and AML sources of TDS were reduced first. After that, various percent reductions were applied to active mining sources until the maximum daily average TDS concentration goal of 369 mg/L was achieved in the Phillips Creek watershed. Then, variable reductions were applied to active mining sources and pre-law mine discharges in downstream portions of South Fork Pound River and adjusted in order to minimize the overall load reductions needed. A summary of the percent reductions, the resulting maximum daily average concentration, the corresponding annual TDS load, and the overall percent load reduction for a number of scenarios are shown in Table ES-8.

Table ES- 7. Allocation Reduction Scenarios for Phillips Creek and South Fork Pound River

Allocations can be found in the amendment attached to the end of this document: Amendment to the TMDL document, titled *North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments Wise County, Virginia* (Initially submitted to VADEQ April 2010)

South Fork Pound River Phased TDS TMDLs

The phased TDS TMDLs for the two impaired segments were calculated using the following equation:

$$TMDL = \sum WLA + \sum LA + MOS$$

where $\sum WLA$ = sum of the wasteload (permitted) allocations;

$\sum LA$ = sum of load (nonpoint source) allocations; and

MOS = margin of safety.

The MOS used in this TMDL was implicit, based on the use of the conservative 90th percentile of observed TDS concentrations in the reference watershed for setting the TMDL TDS concentration endpoint. In Lower Dismal Creek, the 90th percentile values were actually 15.5% lower than the maximum observed values. The WLA was calculated as the combined loads from mining sources from a combination of surface runoff, interflow, and groundwater loads, based on reductions in the TMDL allocation scenario (Run 8 in Table 7.8). Individual WLAs for each mining permit were based on the proportionate area of each permit within each of the 19 modeling sub-watersheds multiplied times the TDS load from permitted mining sources in each sub-watershed. The LA component load was calculated as the TDS load from road salts, residential land uses, and allocation scenario groundwater loads from sub-watersheds without mining permits. The overall load reductions required to attain the 369 mg/L TDS endpoint in Phillips Creek and the South Fork Pound River were 95.5% and 71.2%, respectively, as shown in Table ES- 7. The TMDL and its component loads for the Phillips Creek and South Fork Pound River TDS TMDLs and their component loads are shown in Table ES- 8 and Table ES- 9, respectively.

Table ES- 8. Phillips Creek Phased TDS TMDL (kg/yr)

Allocations can be found in the amendment attached to the end of this document: Amendment to the TMDL document, titled *North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments Wise County, Virginia* (Initially submitted to VADEQ April 2010)

Table ES- 9. South Fork Pound River Phased TDS TMDL (kg/yr)

Allocations can be found in the amendment attached to the end of this document: Amendment to the TMDL document, titled *North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments Wise County, Virginia* (Initially submitted to VADEQ April 2010)

In this watershed, after source characterization and modeling were completed, AML areas, pre-law mine discharges, and active mining sources were assessed as the primary contributors of TDS. AML reclamation and improved source reduction and site management of active mining areas should be the primary targets of implementation efforts.

Components of the Phased TDS TMDLs

The South Fork Pound River Phased TMDLs for TDS will be developed in accordance with EPA's 2006 Guidance on Phased TMDL and will include the following components:

1. For the phased TDS TMDL, TDS loads will be calculated for each mining permit based on simulated loads with all TDS sources turned off except those related to permitted mining. The TDS loads from each sub-watershed will then be apportioned on an area-basis to all permits within each sub-watershed. TDS loads attributed to each permit will be summed from all sub-watersheds that included part of each permit's area.
2. Expanded DMLR requirements, as noted in a March 30, 2009 Memorandum to coal mining permittees, will include TDS monitoring at all outfalls in watersheds where an Aquatic Life Use impairment has been identified, in addition to those where TDS has already been identified as a stressor.

3. Although difficult to quantify, additional monitoring is needed to more accurately distinguish between levels of TDS attributable to permitted mining from surface runoff, interflow and groundwater.

Reasonable Assurance of Implementation

TMDL Compliance Monitoring

DEQ will continue monitoring stations 6APNK000.08, 6APNS000.40, and 6APNS008.73 in accordance with its biological monitoring program, and TDS and TSS at station 6APNK000.08 and 6APNS003.38 in accordance with its ambient monitoring program. DEQ will continue to use data from these monitoring stations and related ambient monitoring stations to evaluate improvements in the benthic community and the effectiveness of TMDL implementation in attainment of the general water quality standard.

DMLR requires all NPDES discharge permittees to monitor total dissolved solids (TDS) in TMDL watersheds where aquatic life use impairments have been identified. Additionally, in a March 30, 2009 Memorandum to all coal mining permittees, DMLR is now requiring permittees to analyze for TSS during qualifying precipitation events, where previously only an alternative parameter – settleable solids – was required. Therefore, TSS data will be available for the full range of precipitation events up through the 10-yr, 24-hr design storm. BMPs specified in NPDES permits are currently required to control runoff from a 10-yr, 24-hr precipitation event (Title 40 §434, Electronic Code of Federal Regulations). The enhanced TMDL stressor monitoring will be in accordance with DMLR's monitoring guidance DMME, 2008.

Since TMDLs are expressed in terms of annual loads, discharge flow rates should be measured concurrently with water quality sampling, and recorded together with daily precipitation data monitored by DMLR-approved sources. When monitoring indicates that the TMDL TDS WLAs are being exceeded DMLR will implement the agency's Waste Load Reduction Actions.,

Regulatory Framework

The goal of the TMDL program is to establish a three-step path that will lead to attainment of water quality standards. The first step in the process is to develop TMDLs that will result in meeting water quality standards. This report represents the culmination of the first step for the benthic impairments on the Lower North Fork and South Fork Pound River. The second step is to develop a TMDL implementation plan. The final step is to implement a TMDL implementation plan. The final step is to implement the TMDL implementation plan and to monitor stream water quality to determine if water quality standards are being attained.

Watershed stakeholders will have opportunities to provide input and to participate in the development of the implementation plan, which will also be supported by regional and local offices of DEQ, Virginia Department of Conservation and Recreation (DCR), DMME, and other cooperating agencies.

Implementation

Implementation of this TMDL will contribute to on-going water quality improvement efforts in the Lower North Fork and South Fork Pound River watersheds. Improvements in the watershed are underway for the control of suspected sources of sediment. These include the on-going efforts to re-mine and reclaim all previously abandoned mine land.

Public Participation

Public participation was elicited throughout TMDL development in order to receive inputs from stakeholders and to apprise the stakeholders of the progress made. Three Technical Advisory Committee (TAC) meetings were held, one in January 2007, one in August 2007, and another in March 2008. The January meeting was followed by a watershed tour with members of the TAC. The first public meeting was held in January 2007 and a second public meeting was held on March 24, 2008. All meetings were held at the Pound Town Hall in Pound, Virginia.

Due to major revisions to the draft TMDLs, another public meeting was held on September 25, 2008 to present the revised draft sediment and TDS TMDLs. This meeting was also held at the Pound Town Hall in Pound, Virginia. This public meeting was attended by 21 stakeholders. The public comment period ended on October 24, 2008.

Uncertainties related to the modeling and source differentiation led to the development of phased TMDLs which will be presented at a public meeting scheduled for February 2, 2010. Public comment on the phased TMDLs for North Fork and South Fork Pound River may be submitted to DEQ until the end of the 30-day comment period on March 4, 2010.

CHAPTER 1: INTRODUCTION

Background

1.1.1. TMDL Definition and Regulatory Information

Section 303(d) of the Federal Clean Water Act and the U.S. Environmental Protection Agency's (USEPA) Water Quality Planning and Management Regulations (40 CFR Part 130) require states to identify water bodies that violate state water quality standards and to develop Total Maximum Daily Loads (TMDLs) for such water bodies. A TMDL reflects the total pollutant loading a water body can receive and still meet water quality standards. A TMDL establishes the allowable pollutant loading from both point and nonpoint sources for a water body, allocates the load among the pollutant contributors, and provides a framework for taking actions to restore water quality.

1.1.2. Impairment Listing

The South Fork Pound River was originally listed as impaired on Virginia's 1994 Section 303(d) Total Maximum Daily Load Priority List and Report due to water quality violations of the general aquatic life (benthic) standard. In 1996, a segment of the North Fork Pound River below North Fork Pound Lake was also added. As a result, the USEPA added these segments to a 1998 consent order requiring TMDLs by May 2010. Since then, two headwater tributaries to the South Fork Pound River – Donald Branch and Phillips Creek – were additionally added to the 305(b) list in 2002 as one segment.

The Virginia Department of Environmental Quality (DEQ) has delineated the benthic impairment as 8.61 miles on the South Fork Pound River (stream segment VAS-Q13R-01); 1.11 miles on the North Fork Pound River (VAS-Q13R-02); and 1.87 and 2.14 miles, respectively, on Donald Branch and Phillips Creek (VAS-Q13R-04). The impaired Donald Branch and Phillips Creek extend from their headwaters to their confluence – the beginning of the South Fork Pound River. The impaired stream segment on the South Fork Pound River includes the entire main stem from the confluence of the two impaired headwater segments and extends to the confluence of the North and South Forks of Pound River. The impaired segment on the North Fork Pound River extends from the North Fork Pound Lake dam downstream to its confluence with the South Fork Pound River. Because of pre-law mining modifications, Donald Branch no longer exists as a surface feature. Therefore, while the Donald Branch sub-watershed will be subject to reductions called for to address the downstream impaired segment on South Fork Pound River, a separate TMDL will not be developed for Donald Branch.

1.1.3. Watershed Location and Description

A part of the Big Sandy River basin, the North Fork and South Fork Pound River watersheds comprise the upstream portion of state hydrologic unit Q13 (the complete National Watershed Boundary Dataset watershed BS28), and are located south and west of the town of Pound in Wise County, Virginia, as shown in Figure 1.1. The combined watersheds are 23,364 acres in size. The main land use category in the combined watersheds is forest, which, in the year 2000, comprised approximately 68% of the total watershed area. The remainder included 23% in mining-related land uses, 5% in agriculture, and 4% in urban/residential land uses. Phillips Creek and Donald Branch flow into the South Fork Pound River. The North and South Forks of Pound River flow into the Pound River which flows northeasterly into Russell Fork, which flows northwesterly into Kentucky, where it enters the Levisa Fork. Levisa Fork flows into the Big Sandy River, which then flows into the Ohio River, then into the Mississippi River, and on to the Gulf of Mexico.

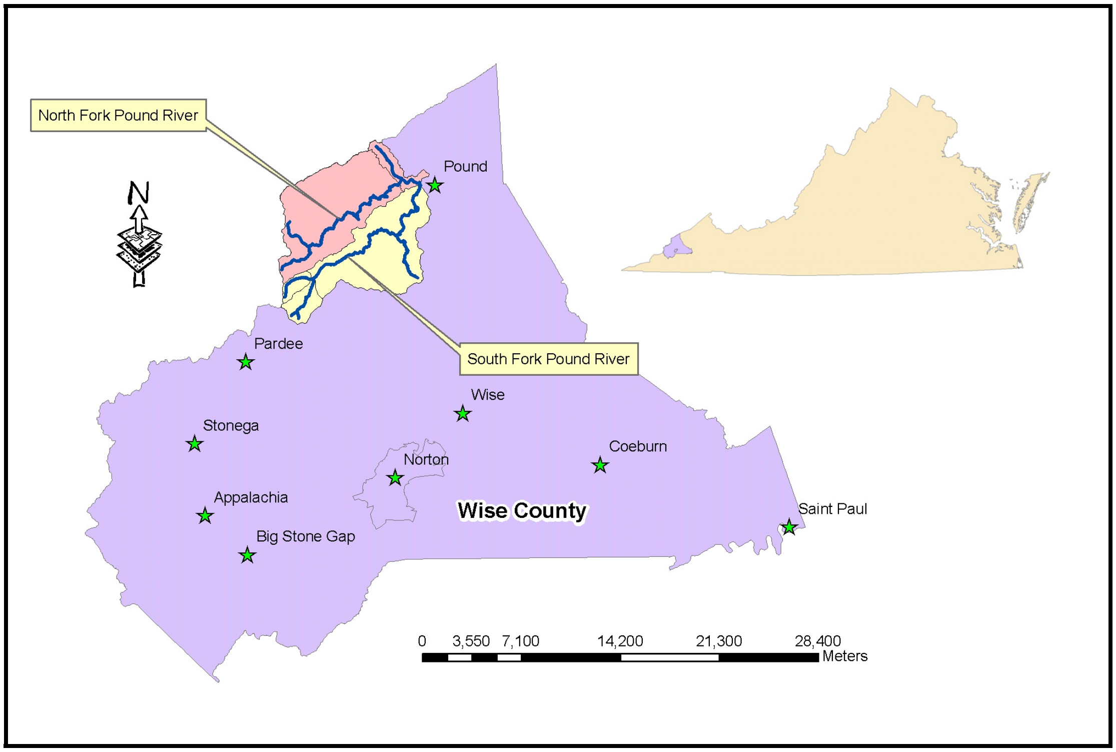

Figure 1.1. North Fork and South Fork Pound River Watersheds

1.1.4. Pollutants of Concern

Pollution from both point and nonpoint sources can lead to a violation of the general standard for water quality. A violation of this standard is assessed on the basis of measurements of the in-stream benthic macro-invertebrate community, with pollution impacts referred to as a benthic impairment. Water bodies having a benthic impairment are not fully supportive of the aquatic life designated use for Virginia's waters.

Designated Uses and Applicable Water Quality Standards

1.1.5. Designation of Uses (9 VAC 25-260-10)

"A. All state waters are designated for the following uses: recreational uses (e.g. swimming and boating); the propagation and growth of a balanced indigenous population of aquatic life, including game fish, which might reasonably be expected to inhabit them; wildlife; and the production of edible and marketable natural resources (e.g., fish and shellfish)." SWCB, 2002.

1.1.6. General Standard (9 VAC 25-260-20)

The general standard for a water body in Virginia is stated as follows:

> "A. All state waters, including wetlands, shall be free from substances attributable to sewage, industrial waste, or other waste in concentrations, amounts, or combinations which contravene established standards or interfere directly or indirectly with designated uses of such water or which are inimical or harmful to human, animal, plant, or aquatic life.
>
> Specific substances to be controlled include, but are not limited to: floating debris, oil scum, and other floating materials; toxic substances (including those which bioaccumulate); substances that produce color, tastes, turbidity, odors, or settle to form sludge deposits; and substances which nourish undesirable or nuisance aquatic plant life. Effluents which tend to raise the temperature of the receiving water will also be controlled." SWCB, 2002.

The biological monitoring program in Virginia that is used to evaluate compliance with the above standard is run by the Virginia Department of Environmental Quality (DEQ). Evaluations of monitoring data from this program focus on the benthic (bottom-dwelling) macro (large enough to see) invertebrates (insects, mollusks, crustaceans, and annelid worms) and are used to determine whether or not a stream segment has a benthic impairment. Changes in water quality generally result in alterations to the quantity and diversity of the benthic organisms that live in streams and other water bodies. Besides being the major intermediate constituent of the aquatic food chain, benthic macro-invertebrates are "living recorders" of past and present water quality conditions. This is due to their relative immobility and their variable resistance to the diverse contaminants that are introduced into streams. The community structure of these organisms provides the basis for the biological analysis of water quality. Both qualitative and semi-quantitative biological monitoring have been conducted by DEQ since the early 1970's. The U.S. Environmental Protection Agency's (USEPA) Rapid Bioassessment Protocol (RBP) II was employed beginning in the fall of 1990 to utilize standardized and repeatable assessment methodology. For any single sample, the RBP produces water quality ratings of "non-impaired," "slightly impaired," "moderately impaired," or "severely impaired." In Virginia, benthic samples are typically collected and analyzed twice a year in the spring and in the fall.

The RBP II procedure evaluates the benthic macro-invertebrate community by comparing ambient monitoring "network" stations to "reference" sites. A reference site is one that has been determined to be representative of a natural, non-impaired water body. The RBP II evaluation also accounts for the natural variation noted in streams in different eco-regions. One additional product of the RBP evaluation is a habitat assessment. This is a stand-alone assessment that describes bank condition and other stream and riparian corridor characteristics and serves as a measure of habitat suitability for the benthic community.

Beginning in 2006, DEQ switched their bioassessment procedures. While the RBP II protocols were still followed for individual metrics, a new index, the Virginia Stream Condition Index (VaSCI), was developed based on comparison of observed data to a set of reference conditions, rather than with data from a reference station. The new index was also calculated for all previous samples in order to better assess trends over time.

Determination of the degree of support for the aquatic life designated use is based on biological monitoring data and the best professional judgment of the regional biologist, relying primarily on the most recent data collected during the current 5-year assessment period. In Virginia, any stream segment with an overall rating of “moderately impaired” or “severely impaired” is placed on the state’s 303(d) list of impaired streams (DEQ, 2002).

CHAPTER 2: WATERSHED CHARACTERIZATION

Water Resources

DEQ has delineated the benthic impairment on the South Fork Pound River (segment VAS-Q13R-01) as a stream length of 8.61 miles. The watershed draining to stream segment VAS-Q13R-01 also includes the watershed draining to 2.14 miles of Phillips Creek, segment VAS-Q13R-04. The impaired stream segment on the South Fork Pound River begins at the downstream confluence with the North Fork Pound River and extends upstream to the confluence of the former Donald Branch and Phillips Creek. The delineated impaired segment on the North Fork Pound River (segment VAS-Q13R-02) is 1.11 miles long and extends from its downstream confluence with the South Fork, upstream to the North Fork Pound Lake dam. The impaired segments and corresponding watersheds are shown in Figure 2.1.

Eco-region

The North Fork and South Fork Pound River watersheds are located entirely within the Cumberland Mountains sub-division of the Central Appalachians eco-region. The Central Appalachians is primarily a high, dissected, rugged plateau which is composed of sandstone, shale, conglomerate and coal. The land cover is mostly forested due to rugged terrain, cool climate and infertile soils limiting agriculture. Bituminous coal mines are common in this region that may cause siltation and acidification of streams (USEPA, 2002).

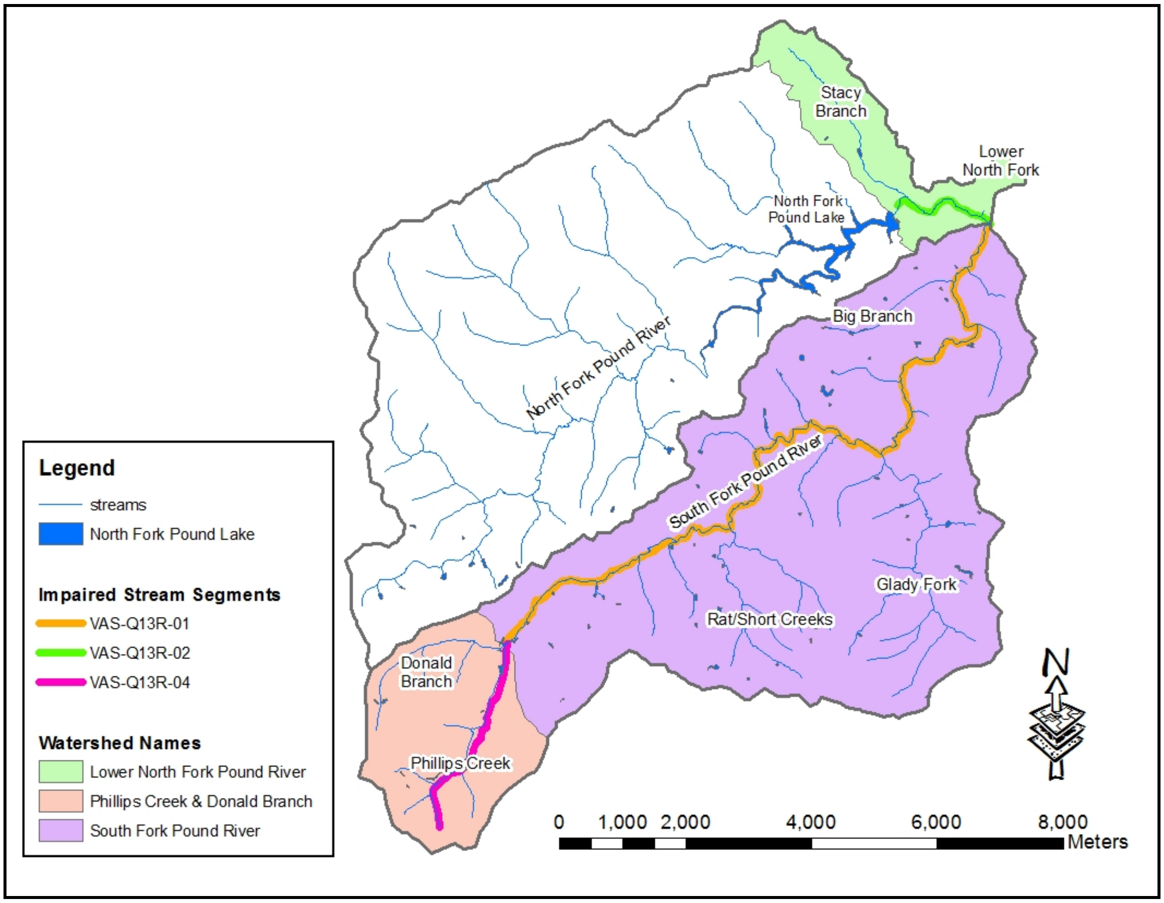

Figure 2.1. Impaired Segments of North Fork and South Fork Pound River

Soils and Geology

The soils found in the North Fork and South Fork Pound River watersheds are primarily in the Berks-Pineville-Rock Outcrop soil association (85.4%). The Berks series (loamy-skeletal, mixed, active, mesic Typic Dystrudepts) consists of moderately deep, well drained soils formed in residuum weathered from shale, siltstone and fine grained sandstone on rounded and dissected uplands. Slopes range from 0 to 80 percent. Permeability is moderate or moderately rapid. The Pineville series (fine-loamy, mixed, active, mesic Typic Hapludults) consists of very deep, well-drained soils with moderately rapid permeability. These soils formed in colluvium derived from sandstone, shale, and siltstone. Pineville soils are on mountain coves, lower side slopes, and foot slopes. Slopes range from 8 to 80 percent but mainly range between 25 and 60 percent (USDA-NRCS, 2007).

Soils in the Kimper-Shelocta-Hazleton association also occur along small portions of the northern and western edges of the North and South Fork Pound River watersheds. The Kimper series (fine-loamy, mixed, semiactive, mesic Typic Dystrudepts) consists of deep and very deep, well drained soils formed in loamy colluvium or colluvium and residuum weathered from sandstone, siltstone and shale. Permeability is moderate to moderately rapid. These sloping to very steep soils are mostly on mountain sides. Slopes range from 5 to 95 percent, but are dominantly 30 to 75 percent. The Shelocta series (fine-loamy, mixed, active, mesic Typic Hapludults) consists of deep and very deep, well drained, moderately permeable soils formed in mixed colluvium from shale, siltstone, and sandstone or colluvium and residuum. They are on steep concave mountain sides, foot slopes, and benches. Slopes range from 2 to 90 percent. The Hazleton series (loamy-skeletal, siliceous, active, mesic Typic Dystrudepts) consists of deep and very deep, well-drained soils formed in residuum of acid gray, brown or red sandstone on uplands. Slopes range from 0 to 80 percent. Permeability is moderately rapid to rapid (USDA-NRCS, 2007).

Climate

Climate data for the North Fork and South Fork Pound River watersheds were based on meteorological observations made by National Climatic Data Center stations located within Wise County, Virginia. The North Fork Pound Lake weather station (446173) lies within the North Fork Pound River watershed, with an average annual precipitation of 47.13 inches. Since temperature data were not recorded at this station, temperature data were obtained from a nearby station. The next closest station to the North Fork and South Fork Pound River watersheds is the Wise 3E station (449215) which lies 6.0 miles (9.6 km) southeast of the watershed. Average annual daily temperature at the Wise station is 53.2°F. The highest average daily temperature of 82.1°F occurs in July while the lowest average daily temperature of 23.2°F occurs in January, as obtained from the 1971-2000 climate normals (NCDC-NOAA, 2007).

Existing Land Use

Land uses for the North Fork and South Fork Pound River watersheds were derived from the Mid-Atlantic Regional Earth Science Application Center (RESAC, 2000), modified with abandoned mine land (AML) features digitized from USGS 7½-minute topographic maps, and merged with a digital map of current mining permit boundaries from the Virginia Department of Mines, Minerals, and Energy's (DMME) Division of Mine Land Reclamation (DMLR). The RESAC data are available from the Virginia Department of Conservation and Recreation (DCR) upon request and were derived from digital remote sensing and spatial information technologies. Some additional editing was done to reclassify portions of the "barren" and "extractive" classifications which were inconsistent with features observed in aerial imagery from the Virginia Base Mapping Program (VBMP, 2007). The 38 land uses in the RESAC data were categorized into 10 categories, and then three mined land use categories added for spatial analysis based on the digitized AML and permit boundaries: AML, AML within a permit (to be reclaimed), and other permit areas (new mining). Broad categories of land uses in the North Fork and South Fork Pound River watersheds are shown in Figure 2.2, while a detailed distribution of the 13 categories is tabulated in Table 2.1. Further refinements to these land use categories were made during model development, as discussed in Chapter 5.

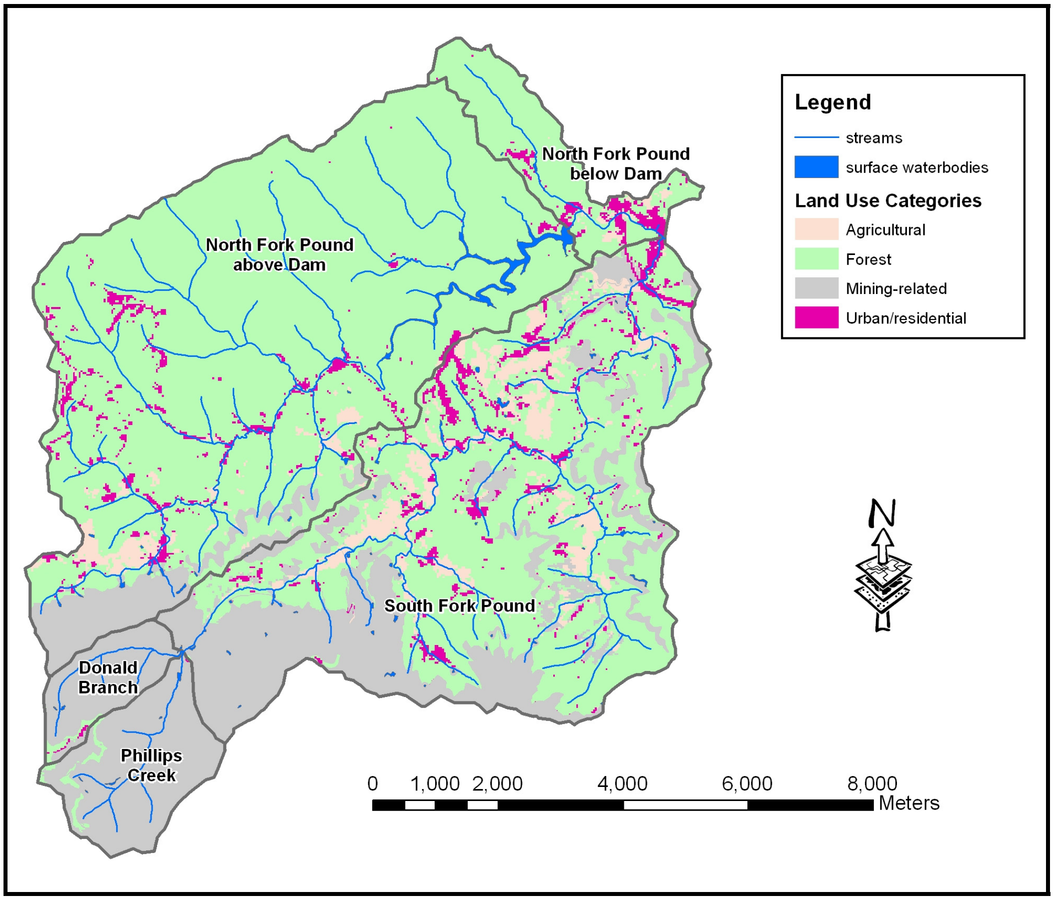

Figure 2.2. Land Use in North Fork and South Fork Pound River Watersheds

Table 2.1. North Fork and South Fork Pound River Land Use Category Distribution

Land Use Description	**Broad Land Use Category**	**North Fork above Reservoir (ha)**	**North Fork below Reservoir (ha)**	**South Fork Pound River (ha)**	**Phillips Creek* (ha)**
Low Intensity Developed	Residential/Urban	11.2	6.4	16.5	0.0
Medium Intensity Developed	Residential/Urban	0.4	2.2	0.4	0.0
High Intensity Developed	Residential/Urban	6.0	9.6	12.6	0.0
Transportation	Residential/Urban	0.0	6.1	6.1	0.0
Extractive	Mining-Related	110.1	0.3	648.3	137.0
Barren	Residential/Urban	116.3	20.9	205.6	10.4
Pasture / Hay	Agriculture	95.6	19.4	349.0	1.1
Croplands	Agriculture	11.9	0.0	19.5	0.1
Forest	Forest	3,948.8	400.9	2,821.8	339.8
AML	Mining-Related	82.3	0.0	303.3	4.2
Reclaimed	Mining-Related	54.6	0.0	152.5	9.9
Released	Mining-Related	0.1	0.0	9.7	1.2
Total Area		**4,437.2**	**465.9**	**4,545.3**	**503.8**
* Includes Donald Branch	Agriculture	2%	4%	8%	0%
	Forest	89%	86%	62%	67%
	Mining-Related	6%	0%	25%	30%
	Residential/Urban	3%	10%	5%	2%

Accommodations for Future Growth

Land use in the North Fork and South Fork Pound River watersheds was assumed to remain similar to existing conditions for the foreseeable future. Although mining continues within existing permitted areas, the amount of land disturbed at any one time remains approximately the same, since current guidance requires permit holders to minimize disturbed footprints and to reclaim disturbed areas as soon as possible. The two changes included to account for future growth included allowances for increases in permitted WLA. The permitted mining acreage and corresponding waste load allocation (WLA) was increased by 10% to allow for future growth in mining, and an additional allocation was included to allow for anticipated growth in the gas and oil industry. No other significant land use changes are expected.

Biological Monitoring Data

Biological monitoring consisted of sampling the benthic macro-invertebrate community together with corresponding habitat assessments. The biological monitoring stations on the North Fork Pound River consisted of one primary station – 6APNK000.08 (located downstream of the North Fork Pound Lake) – and two upstream stations – 6APLL000.17 and 6APNK008.28 – each of which were sampled only once. Station 6APNK000.08 was sampled 14 times between 1990 and 2000 and twice in 2006. The DEQ 2004 Fact Sheets for Category 5 Waters (DEQ, 2004) state that the North Fork Pound River segment is moderately impaired due to urban sources of pollution and/or habitat degradation due to lake discharge. The initial listing of the North Fork Pound River segment was during the 1996 assessment.

The biological monitoring stations on the South Fork Pound River also consisted of one primary station - 6APNS000.40 (located near the outlet) - and three other upstream stations – 6APNS003.94, 6APNS004.98, and 6APNS008.73. Each of the upstream stations was sampled in either 1999 or 2001, and stations 6APNS004.98 and 6APNS008.73 were sampled twice in 2006. The farthest upstream station on the South Fork Pound River –

6APNS008.73 – is the listing station for Phillips Creek, whose confluence with the former Donald Branch is the beginning of the South Fork main stem. The DEQ 2004 Fact Sheets for Category 5 Waters (DEQ, 2004) state that the biological stations on the South Fork Pound River segment have been consistently rated as either moderately or severely impaired. The initial listing of the South Fork Pound River segment was during the 1994 assessment, with the cause of the benthic impairment listed as resource extraction. One stream section was also listed as a "water of concern" for an exceedence of the nickel consensus value in one sediment sample. The two stream segments above station 6APNS008.73 were both listed as extremely impaired due to resource extraction.

The locations of these DEQ biological and ambient monitoring stations in the North and South Forks of the Pound River watersheds are shown in Figure 2.3 together with the major tributary sub-watersheds referred to during this report. From this point in the report, the stations are referred to without their initial regional designation "6A" in order to simplify legends and references.

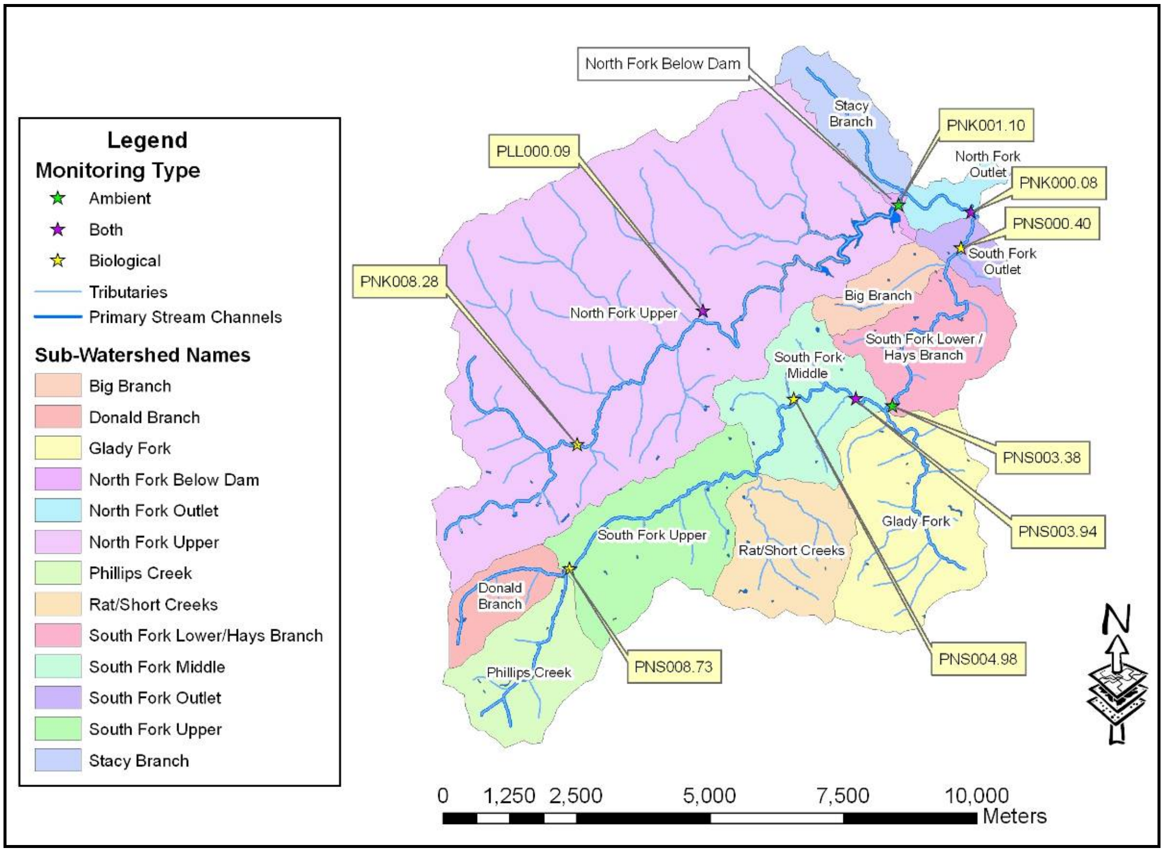

Figure 2.3. Locations of DEQ Monitoring Stations in North Fork and South Fork Pound River Watersheds

Each biological sample was collected from a cross-section of the stream channel and from both pool and riffle environments. The organisms in each sample were separated out into identifiable taxa (either families or species), and then a count was made of the number of organisms in each taxa. A full listing of the taxa inventory or distribution within each biological sample is given in Table 2.2 for all stations in the North Fork Pound River watershed, and in Table 2.3 for all stations in the South Fork Pound River watershed.

Table 2.2. North Fork Pound River Benthic Species Distribution by Sample Date

Taxa	Tolerance Value	Functional Family Group	Habit	North Fork Pound River Stations and Collection Dates																	
				PLL000.17	PNK000.08																PNK008.28
				06/25/01	10/03/90	04/02/91	10/17/91	06/17/92	11/30/92	10/26/93	05/17/94	10/05/94	04/17/96	11/07/97	06/08/98	12/03/98	10/04/99	10/27/00	05/10/06	11/28/06	12/08/04
Glossosomatidae		Scraper	clinger																		
Leuctridae		Shredder		5															1		
Rhyacophilidae		Predator	clinger																		
Capniidae	1	Shredder																			3
Gomphidae	1	Predator	burrower											2			2				
Perlidae	1	Predator	clinger	6																	2
Athericidae	2	Predator	sprawler																		
Isonychiidae	2	Filterer	swimmer									11	4	5	3					11	
Leptophlebiidae	2	Collector	swimmer					1													
Nemouridae	2	Shredder	sprawler			2							47						15		
Perlodidae	2	Predator	clinger			4		1													5
Taeniopterygidae	2	Shredder	sprawler						39	3	2			63		41				40	9
Aeshnidae	3	Predator	climber				1														
Philopotamidae	3	Collector	clinger	23	2	1			1	7		4	2	5				3			
Tipulidae	3	Shredder	burrower	3	1			1		3	1	13		2				1			1
Uenoidae	3	Scraper	clinger																		7
Baetidae	4	Collector	swimmer	24		6		3								3			11		3
Caenidae	4	Collector	sprawler																		
Elmidae	4	Scraper	clinger	14							1	1		1		3	4	7	8	17	2
Ephemerellidae	4	Collector	clinger			38	1	1					4		4			2	1		
Heptageniidae	4	Scraper	clinger		22	2	36	5	24	27	3	43	5	6	2	31	37	42	1	1	2
Leptoceridae	4	Collector						5													
Psephenidae	4	Scraper	clinger	7																	
Sialidae	4	Predator	burrower																		
Cambaridae	5	Shredder		1							1										
Corydalidae	5	Predator	clinger	2		1	2	1				1		1		2			1		1
Hydrachnidae	5	Predator																			
Ceratopogonidae	6	Predator	burrower																		
Chironomidae (A)	6	Collector		6	6	8		14	3		11		29	4	18	9	10		28	7	32
Empididae	6	Predator	sprawler					1			2				1						1
Hydropsychidae	6	Filterer	clinger	7	64	39	47	9	25	36	3	21		7		15	29	46	4	26	22
Hydroptilidae	6	Scraper	clinger																		
Simuliidae	6	Filterer	clinger					48	4	1	3			2	4		3		22	3	1
Veliidae	6	Predator	skater																		
Haliplidae	7	Shredder	climber					1					2								
Planorbidae	7	Scraper																	3		
Corbiculidae	8	Filterer	sprawler			2	2	2	1	3	5	2		1	5		1	3	1	4	
Lumbriculidae	8	Collector			1			5		2	1	1							6		
Naididae	8	Collector	burrower				1														
Physidae	8	Scraper									1	1									
Sphaeriidae	8	Filterer	sprawler		1																
Psychodidae	10	Collector	burrower																		
Tubificidae	10	Collector	burrower			1				1											
Oligoneuriidae					15		16	2	9	15						1	9	7			
No. of Species				**11**	**8**	**11**	**8**	**16**	**8**	**10**	**12**	**10**	**7**	**12**	**7**	**8**	**8**	**8**	**13**	**8**	**14**
Total Abundance				**98**	**112**	**104**	**106**	**100**	**106**	**98**	**34**	**98**	**93**	**99**	**37**	**105**	**95**	**111**	**102**	**109**	**91**

- Dominant 2 organisms in each sample.

Additional Benthic Metrics

Scraper/Filterer-Collecto	0.35	0.30	0.02	0.71	0.06	0.71	0.54	0.22	1.15	0.13	0.29	0.06	1.26	0.95	0.91	0.16	0.35	0.19
%Filterer-Collector	61.2%	66.1%	91.3%	48.1%	88.0%	32.1%	51.0%	67.6%	39.8%	41.9%	24.2%	91.9%	25.7%	45.3%	48.6%	71.6%	46.8%	63.7%
%Haptobenthos	60.2%	78.6%	81.7%	81.1%	65.0%	50.9%	72.4%	29.4%	71.4%	11.8%	22.2%	27.0%	48.6%	76.8%	90.1%	36.3%	43.1%	46.2%
%Shredder	9.2%	0.9%	1.9%		2.0%	36.8%	6.1%	11.8%	13.3%	52.7%	65.7%		39.0%		0.9%	15.7%	36.7%	14.3%

Habit Codes: bur = burrowers; ska = skaters;
cli = clingers; spr = sprawlers;
clm = climbers; swi = swimmers.

Table 2.3. South Fork Pound River Benthic Species Distribution by Sample Date

Taxa	Tolerance Value	Functional Family Group	Habit	South Fork Pound River Stations and Collection Dates																							
				PNS000.40																PNS003.94		PNS004.98			PNS008.73		
				10/03/90	05/23/91	10/17/91	06/17/92	11/30/92	10/26/93	05/17/94	10/05/94	04/17/96	11/07/97	06/08/98	12/03/98	10/04/99	10/27/00	05/10/06	11/28/06	06/18/01	10/29/01	10/04/99	05/10/06	11/28/06	10/04/99	05/10/06	11/28/06
Glossosomatidae		Scraper	clinger					1																			
Rhyacophilidae		Predator	clinger			1																					
Capniidae	1	Shredder						5					2						3					2			
Gomphidae	1	Predator	burrower														1										
Perlidae	1	Predator	clinger																				3				
Athericidae	2	Predator	sprawler										1		2		16		1	1	3						
Nemouridae	2	Shredder	sprawler		6							2						2									
Taeniopterygidae	2	Shredder	sprawler					25	4				60		33		7		8								
Philopotamidae	3	Collector	clinger			4		1			5		2	1	3				3					3			
Tipulidae	3	Shredder	burrower	1		4					2									2			4	4			2
Baetidae	4	Collector	swimmer	4	14	6			1		4																
Elmidae	4	Scraper	clinger	1	1	1	3	4	1		13	5	10	19	3	22	8	4	6	46	64	36	1	3			
Ephemerellidae	4	Collector	clinger																				1				
Heptageniidae	4	Scraper	clinger				1																				
Psephenidae	4	Scraper	clinger														1	1									
Sialidae	4	Predator	burrower																						1		
Cambaridae	5	Shredder									1																
Corydalidae	5	Predator	clinger	2		1	3	2	4	1	3			2			2					1		1		3	
Hydrachnidae	5	Predator																						1			
Ceratopogonidae	6	Predator	burrower																				5		1		
Chironomidae (A)	6	Collector		3	10	2	11	9	4	16	5	20	8	27	19	5	4	58	18	23	1	17	60	26	103	77	71
Empididae	6	Predator	sprawler									3	6				3	7	4		2		13	4		1	1
Hydropsychidae	6	Filterer	clinger	93	55	83	17	48	99	3	17	28	21	41	49	79	71	19	48	23	26	45	2	61	2		4
Hydroptilidae	6	Scraper	clinger																1				1				
Simuliidae	6	Filterer	clinger		19						5		3		3	5	2	1								10	24
Veliidae	6	Predator	skater																	1							
Planorbidae	7	Scraper				1																					
Corbiculidae	8	Filterer	sprawler													1	2	1	12								
Lumbriculidae	8	Collector					1							2			2		1				3		2		1
Naididae	8	Collector	burrower																1				1			1	
Sphaeriidae	8	Filterer	sprawler																								3
Psychodidae	10	Collector	burrower																							1	
Tubificidae	10	Collector	burrower	1														1									
Oligoneuriidae						8			1		3																
No. of Species				**7**	**6**	**10**	**6**	**8**	**7**	**3**	**10**	**5**	**9**	**6**	**7**	**5**	**12**	**9**	**13**	**6**	**5**	**4**	**11**	**9**	**5**	**6**	**7**
Total Abundance				**105**	**105**	**111**	**36**	**95**	**114**	**20**	**58**	**58**	**113**	**92**	**112**	**112**	**119**	**94**	**107**	**96**	**96**	**99**	**94**	**105**	**109**	**93**	**106**

- Dominant 2 organisms in each sample.

Additional Benthic Metrics

Scraper/Filterer-Collector	0.01	0.01	0.02	0.14	0.09	0.01		0.36	0.10	0.29	0.27	0.04	0.24	0.11	0.06	0.08	1.00	2.37	0.58	0.03	0.03			
%Filterer-Collector	96.2%	93.3%	85.6%	80.6%	61.1%	91.2%	95.0%	62.1%	82.8%	30.1%	77.2%	66.1%	80.4%	68.1%	85.1%	78.5%	47.9%	28.1%	62.6%	71.3%	85.7%	98.2%	95.7%	97.2%
%Haptobenthos	91.4%	71.4%	81.1%	66.7%	58.9%	91.2%	20.0%	74.1%	56.9%	31.9%	68.5%	51.8%	94.6%	70.6%	26.6%	54.2%	71.9%	93.8%	82.8%	8.5%	64.8%	1.8%	14.0%	26.4%
%Shredder	1.0%	5.7%	3.6%		31.6%	3.5%		5.2%	3.4%	54.9%		29.5%		5.9%	2.1%	10.3%	2.1%			4.3%	5.7%			1.9%

Habit Codes: bur = burrowers; ska = skaters;
cli = clingers; spr = sprawlers;
clm = climbers; swi = swimmers.

The Rapid Bioassessment Protocol II (RBP II) is the official protocol used to assess compliance with the general standard in Virginia (Barbour et al., 1999). The RBP II procedure evaluates the benthic macro-invertebrate community by comparing individual network biomonitoring stations with reference biomonitoring stations. Reference biomonitoring stations have been identified by regional biologists on streams that are both representative of regional physiographic and ecological conditions and have a healthy, non-impaired benthic community. A number of different biological reference stations have been used for bioassessment in the North Fork and South Fork Pound River watersheds over time, including Lower Dismal Creek (6ADIS003.52), Upper Dismal Creek (6ADIS017.94), Dumps Creek (6BDUM000.23), Baileys Trace (6BBAI000.26), South Fork Powell River (6BPLL006.50), and most recently, Burns Creek (6BBUC000.24).

DEQ, with assistance from USEPA Region 3, has recently upgraded its biomonitoring and biological assessment methods to those currently recommended in the mid-Atlantic region. As part of this effort, a study was performed to assist the agency in moving from a paired-network/reference site approach to a regional reference condition approach, and has led to the development of the Virginia Stream Condition Index (VaSCI) for Virginia's non-coastal areas (Tetra Tech, 2002). This multi-metric index is based on 8 biomonitoring metrics, with a scoring range of 0-100, that include some different metrics than those used in the RBP II, but are based on the same taxa inventory. A maximum score of 100 represents the best benthic community sites. The current proposed threshold criteria would define "non-impaired" sites as those with a VaSCI of 60 or above, and "impaired" sites as those with a score below 60 (DEQ, 2006). The VaSCI scores for stations in the North Fork Pound River watershed are given in Table 2.4 and for stations in the South Fork Pound River watershed in Table 2.5. Because of the inconsistent use of a single reference station and the incomplete calculation of RBP II metrics for several samples, the VaSCI ratings were considered to be more reliable when attempting to look for relationships between these overall ratings, individual metrics, and potential pollutants in the stressor analysis. The ratings of all of the biological samples taken at all stations within the North Fork and South Fork Pound River watersheds are depicted graphically in Figure 2.4.

Table 2.4. VaSCI Scores for North Fork Pound River Stations

	North Fork Pound River Stations and Collection Dates																	
	6APLL000.17	PNK000.08																PNK008.28
	06/25/01	10/03/90	04/02/91	10/17/91	06/17/92	11/30/92	10/26/93	05/17/94	10/05/94	04/17/96	11/07/97	06/08/98	12/03/98	10/04/99	10/27/00	05/10/06	11/28/06	12/08/04
VaSCI Metrics																		
TotTaxa	11	8	11	8	16	8	10	12	10	7	12	7	8	8	8	13	8	14
EPTTax	5	4	7	4	8	5	5	3	4	5	5	3	5	3	5	6	4	8
%Ephem	24.5	19.6	44.2	34.9	9.0	22.6	27.6	8.8	55.1	14.0	11.1	24.3	32.4	38.9	39.6	12.75	11	5.5
%PT - Hydropsychidae	34.7	1.8	6.7	0.0	1.0	37.7	10.2	5.9	4.1	52.7	68.7	0.0	39.0	0.0	2.7	15.69	36.7	28.6
%Scrap	21.4	19.6	1.9	34.0	5.0	22.6	27.6	14.7	45.9	5.4	7.1	5.4	32.4	43.2	44.1	11.76	16.5	12.1
%Chiro	6.1	5.4	7.7	0.0	14.0	2.8	0.0	32.4	0.0	31.2	4.0	48.6	8.6	10.5	0.0	27.45	6.42	35.2
%2Dom	48.0	76.8	74.0	78.3	62.0	60.4	64.3	47.1	65.3	81.7	70.7	62.2	68.6	69.5	79.3	49.02	60.6	59.3
MFBI	3.6	5.0	4.9	4.7	5.6	3.7	4.6	5.8	4.2	3.6	2.8	5.6	3.7	4.7	4.8	4.917	3.87	4.7
VaSCI Metric Scores																		
TotTaxa	50.0	36.4	50.0	36.4	72.7	36.4	45.5	54.5	45.5	31.8	54.5	31.8	36.4	36.4	36.4	59.09	36.4	63.6
EPTTax	45.5	36.4	63.6	36.4	72.7	45.5	45.5	27.3	36.4	45.5	45.5	27.3	45.5	27.3	45.5	54.55	36.4	72.7
%Ephem	40.0	32.0	72.2	56.9	14.7	36.9	44.9	14.4	89.9	22.8	18.1	39.7	52.8	63.5	64.7	20.79	18	9.0
%PT - Hydropsychidae	97.5	5.0	18.9	0.0	2.8	100.0	28.7	16.5	11.5	100.0	100.0	0.0	100.0	0.0	7.6	44.06	100	80.3
%Scrap	41.5	38.1	3.7	65.8	9.7	43.9	53.4	28.5	89.0	10.4	13.7	10.5	62.8	83.6	85.6	22.8	32	23.4
%Chiro	93.9	94.6	92.3	100.0	86.0	97.2	100.0	67.6	100.0	68.8	96.0	51.4	91.4	89.5	100.0	72.55	93.6	64.8
%2Dom	75.2	33.5	37.5	31.4	54.9	57.3	51.6	76.5	50.1	26.4	42.3	54.7	45.4	44.1	29.9	73.67	57	58.8
%MFBI	93.5	73.1	74.7	77.8	64.1	92.2	80.1	61.5	85.3	94.6	100.0	64.4	92.9	78.4	76.9	74.75	90.1	78.2
VaSCI Total Scores	**67.1**	**43.6**	**51.6**	**50.6**	**47.2**	**63.7**	**56.2**	**43.4**	**63.4**	**50.0**	**58.8**	**35.0**	**65.9**	**52.8**	**55.8**	**52.8**	**57.9**	**56.4**

Table 2.5. VaSCI Scores for South Fork Pound River Stations

	South Fork Pound River Stations and Collection Dates																							
	PNS000.40																6APNS003.94		PNS004.98			PNS008.73		
	10/03/90	05/23/91	10/17/91	06/17/92	11/30/92	10/26/93	05/17/94	10/05/94	04/17/96	11/07/97	06/08/98	12/03/98	10/04/99	10/27/00	05/10/06	11/28/06	06/18/01	10/29/01	10/04/99	05/10/06	11/28/06	10/04/99	05/10/06	11/28/06
VaSCI Metrics																								
TotTaxa	7	6	10	6	8	7	3	10	5	9	6	7	5	12	9	13	6	5	4	11	9	5	6	7
EPTTax	2	3	5	2	5	4	1	4	2	4	2	3	1	2	2	6	1	1	1	4	3	1		1
%Ephem	3.8	13.3	5.4	2.8	0.0	0.9	0.0	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0	0.93	0.0	0.0	0.0	1.064	0	0.0	0	0
%PT - Hydropsychidae	0.0	5.7	3.6	0.0	32.6	3.5	0.0	8.6	3.4	56.6	1.1	32.1	0.0	5.9	2.128	14	0.0	0.0	0.0	4.255	4.762	0.0		
%Scrap	1.0	1.0	1.8	11.1	5.3	0.9	0.0	22.4	8.6	8.8	20.7	2.7	19.6	7.6	5.319	6.54	47.9	66.7	36.4	2.128	2.857	0.0	0	0
%Chiro	2.9	9.5	1.8	30.6	9.5	3.5	80.0	8.6	34.5	7.1	29.3	17.0	4.5	3.4	61.7	16.8	24.0	1.0	17.2	63.83	24.76	94.5	82.8	67
%2Dom	92.4	70.5	80.2	77.8	76.8	90.4	95.0	51.7	82.8	71.7	73.9	73.2	90.2	73.1	81.91	61.7	71.9	93.8	81.8	77.66	82.86	96.3	93.5	89.6
MFBI	5.9	5.5	5.3	5.8	4.5	5.8	6.0	4.8	5.7	3.5	5.6	4.6	5.6	5.1	5.828	5.55	4.9	4.5	5.3	5.681	5.629	6.0	6.03	6
VaSCI Metric Scores																								
TotTaxa	31.8	27.3	45.5	27.3	36.4	31.8	13.6	45.5	22.7	40.9	27.3	31.8	22.7	54.5	40.91	59.1	27.3	22.7	18.2	50	40.91	22.7	27.3	31.8
EPTTax	18.2	27.3	45.5	18.2	45.5	36.4	9.1	36.4	18.2	36.4	18.2	27.3	9.1	18.2	18.18	54.5	9.1	9.1	9.1	36.36	27.27	9.1	0	9.09
%Ephem	6.2	21.8	8.8	4.5	0.0	1.4	0.0	11.3	0.0	0.0	0.0	0.0	0.0	0.0	0	1.52	0.0	0.0	0.0	1.735	0	0.0	0	0
%PT - Hydropsychidae	0.0	16.1	10.1	0.0	91.7	9.9	0.0	24.2	9.7	100.0	3.1	90.3	0.0	16.5	5.977	39.4	0.0	0.0	0.0	11.95	13.38	0.0	0	0
%Scrap	1.8	1.8	3.5	21.5	10.2	1.7	0.0	43.4	16.7	17.2	40.0	5.2	38.1	14.7	10.31	12.7	92.9	100.0	70.5	4.123	5.537	0.0	0	0
%Chiro	97.1	90.5	98.2	69.4	90.5	96.5	20.0	91.4	65.5	92.9	70.7	83.0	95.5	96.6	38.3	83.2	76.0	99.0	82.8	36.17	75.24	5.5	17.2	33
%2Dom	11.0	42.7	28.6	32.1	33.5	13.9	7.2	69.8	24.9	40.9	37.7	38.7	14.2	38.9	26.13	55.4	40.6	9.0	26.3	32.28	24.77	5.3	9.32	15
%MFBI	60.3	66.3	68.8	62.5	81.2	62.5	59.6	76.9	63.4	95.3	65.0	79.1	64.4	72.4	61.35	65.5	74.4	80.3	69.6	63.51	64.29	59.4	58.3	58.8
VaSCI Total Scores	**28.3**	**36.7**	**38.6**	**29.4**	**48.6**	**31.8**	**13.7**	**49.8**	**27.6**	**52.9**	**32.7**	**44.4**	**30.5**	**39.0**	**25.1**	**46.4**	**40.0**	**40.0**	**34.6**	**29.5**	**31.4**	**12.8**	**14.0**	**18.5**

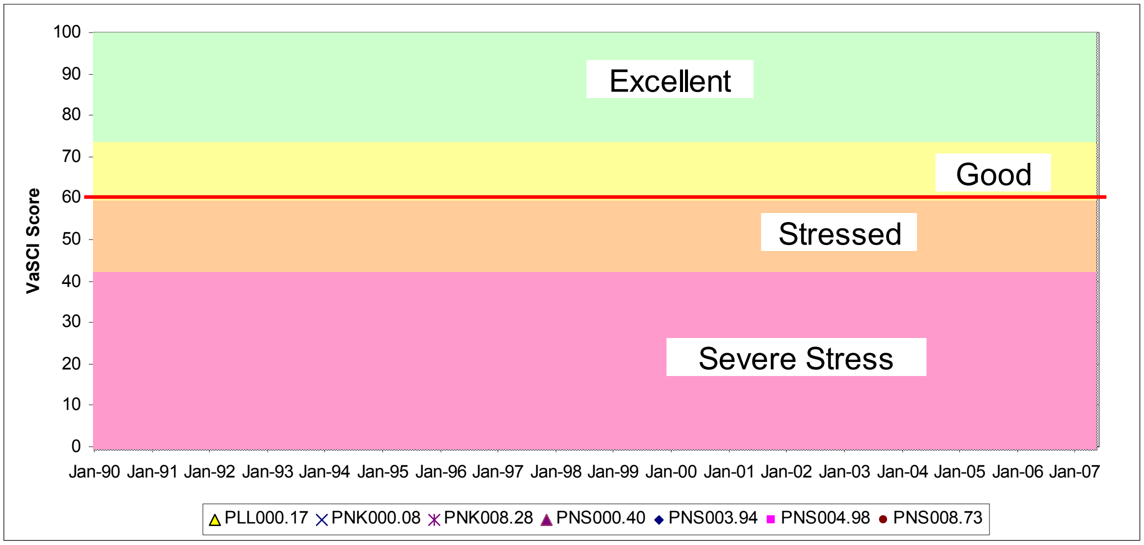

Figure 2.4. VaSCI Scores and Ratings for All Stations, 1990 – 2006

A qualitative analysis of various habitat parameters was conducted in conjunction with each biological sampling event. Each of the 10 parameters listed in Table 2.6 and Table 2.7 were rated on a scale of 0-20, with a maximum score of 20 indicating the most desirable condition, and a score of 0 indicating the poorest habitat conditions. The best possible overall score for a single evaluation is 200. From this table it can be seen that many habitat metrics frequently received poor to marginal ratings, with a slightly greater frequency of poor to marginal ratings at the South Fork Pound River stations.

Table 2.6. Habitat Evaluation Scores for North Fork Pound River Stations

Habitat Metrics		North Fork Pound River Stations and Collection Dates																	
	StationID	PLL000.17	PNK000.08																PNK008.28
	Collection Date	06/25/01	10/03/90	04/02/91	10/17/91	06/17/92	11/30/92	10/26/93	05/17/94	10/05/94	04/17/96	11/07/97	06/08/98	12/03/98	10/04/99	10/27/00	05/10/06	11/28/06	12/08/04
Channel Alteration	ALTER	19	11	14	9	13	12	12	18	17	18	15	16	17	17	16	18	17	18
Bank Stability	BANKS	15	8	10	13	10	8	4	12	10	7	8	11	6	11	7	10	11	9
Bank Vegetation	BANKVEG	18	10	10	14	14	11	7	18	14	18	16	18	18	16	15	17	17	14
Embeddedness	EMBED	15	13	10	5	7	13	12	12	12	9	9	7	6	5	7	7	5	15
Channel Flow Status	FLOW	14	0	12	14	13	10	2	13	18	19	19	18	8	8	13	19	18	19
Frequency of Riffles	RIFFLES	18	10	10	8	8	8	8	10	13	10	10	12	9	6	10	11	16	16
Riparian Vegetation	RIPVEG	14	8	16	15	13	10	4	7	10	13	7	11	7	11	10	16	17	14
Sediment Deposition	SEDIMENT	12	8	13	8	9	8	9	11	14	12	16	7	7	4	15	7	7	13
Substrate Availability	SUBSTRATE	16	17	17	14	16	18	12	16	16	13	12	16	15	6	15	14	16	16
Velocity/Depth Regime	VELOCITY	10	10	13	12	11	13	16	10	15	13	11	13	9	7	15	13	9	10
10-Metric Total		151	95	125	112	114	111	86	127	139	132	123	129	102	91	123	132	133	144

Habitat metric score assessed as "marginal" or "poor".

RBP Habitat Evaluation Ratings
(Bank Stability, Bank Vegetation, Riparian Vegetation): Poor 0-4; Marginal 6-10; Sub-optimal 12-16; Optimal 18-20.
(All others): Poor 0-5; Marginal 6-10; Sub-optimal 11-15; Optimal 16-20.

Table 2.7. Habitat Evaluation Scores for South Fork Pound River Stations

Habitat Metrics		South Fork Pound River Stations and Collection Dates																							
	StationID	PNS000.40																PNS003.94		PNS004.98			PNS008.73		
	Collection Date	10/03/90	05/23/91	10/17/91	06/17/92	11/30/92	10/26/93	05/17/94	10/05/94	04/17/96	11/07/97	06/08/98	12/03/98	10/04/99	10/27/00	05/10/06	11/28/06	06/18/01	10/29/01	10/04/99	05/10/06	11/28/06	10/04/99	05/10/06	11/28/06
Channel Alteration	ALTER	12	6	8	5	8	7	10	11	12	13	17	17	16	12	16	18	17	18	17	18	18	18	18	17
Bank Stability	BANKS	9	8	11	11	9	4	11	9	7	6	7	4	6	7	11	11	14	14	4	8	7	4	10	13
Bank Vegetation	BANKVEG	9	11	13	12	10	7	10	14	13	17	18	17	15	7	10	14	12	11	15	12	10	17	12	14
Embeddedness	EMBED	12	7	11	7	12	12	5	9	7	2	12	4	13	12	9	14	10	7	6	7	8	10	9	7
Channel Flow Status	FLOW	0	14	13	13	12	6	16	12	18	17	19	9	8	13	17	17	11	11	8	19	18	9	16	16
Frequency of Riffles	RIFFLES	8	9	7	5	7	7	7	12	7	7	7	9	7	7	9	11	12	13	6	10	6	11	18	8
Riparian Vegetation	RIPVEG	7	11	10	11	8	2	6	6	9	7	7	7	7	7	8	11	12	10	4	10	11	16	12	13
Sediment Deposition	SEDIMENT	8	9	7	8	7	7	15	12	9	6	7	15	10	7	7	11	5	5	3	6	9	10	15	15
Substrate Availability	SUBSTRATE	19	16	17	12	18	7	17	16	15	15	15	15	14	16	16	17	13	16	6	7	12	17	13	6
Velocity/Depth Regime	VELOCITY	9	11	11	6	12	7	15	14	16	13	6	14	10	14	15	9	16	10	7	14	15	9	10	10
10-Metric Total		93	102	108	90	103	66	112	115	113	103	115	111	106	102	118	133	122	115	76	111	114	121	133	119

Habitat metric score assessed as "marginal" or "poor".

RBP Habitat Evaluation Ratings
(Bank Stability, Bank Vegetation, Riparian Vegetation): Poor 0-4; Marginal 6-10; Sub-optimal 12-16; Optimal 18-20.
(All others): Poor 0-5; Marginal 6-10; Sub-optimal 11-15; Optimal 16-20.

Stream Flow Data

A USGS stream gaging station (USGS03208700) was located in the North Fork Pound River watershed between October 1961 and September 1987. There currently are no active USGS flow stations in either watershed. The U.S. Army Corps of Engineers (USACE), however, does maintain a gaging station at the outfall of the North Fork Pound Lake, which it operates. This lake is a regulated public water supply and is also used for flood control. Because of the flood control use, the water level in the lake is drawn down by approximately 7 feet between October and December each year in order to provide extra storage capacity for winter and spring storm runoff to prevent downstream flooding. The effect of this annual drawdown is obvious in the time series of daily flows shown in Figure 2.5. The influence of this activity on the biological community is unknown. A new DEQ ambient monitoring station was added in 2007 just past the mixing zone from the dam's outfall to assist in this diagnosis.

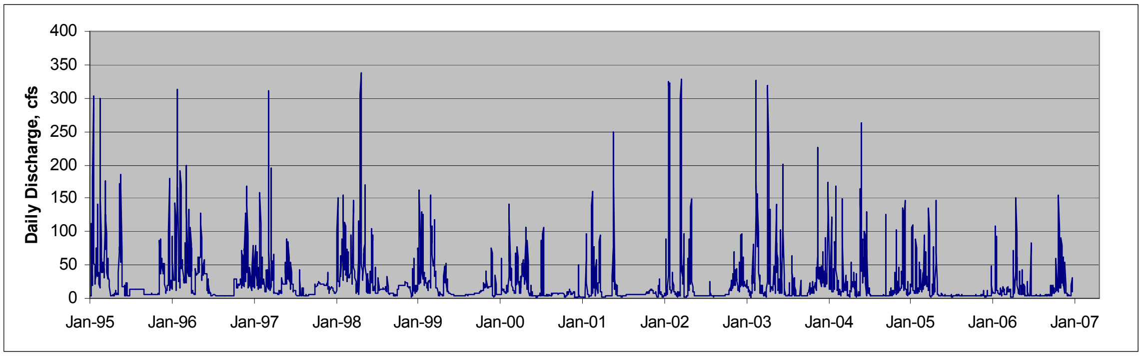

Figure 2.5. USACE Mean Daily Flow at North Fork Pound Lake Outfall

Water Quality Data

2.1.1. DEQ Ambient Monitoring Data

Although the North Fork Pound River impaired segment has been monitored by the PNK000.08 biological station since 1990, ambient sample collection only recently started at the same site in August 2006. A second ambient station just below the mixing zone of the outfall from the North Fork Pound Dam (PNK001.10) was initiated in spring 2007.

Ambient monitoring along the impaired segment of the South Fork Pound River was conducted upstream from the listing biological station at station PNS003.38. No DEQ ambient data were collected near the Phillips Creek impaired segment, although DMLR compliance monitoring is available at a pond outfall below their confluence. Station PNS003.38 was monitored on a monthly basis from 1976 – 1979, and again starting in 2006 through the present. This resulted in a 26-year gap in ambient monitoring on the South Fork. A few select parameters are compared in Table 2.8 between recent sampling at the primary North Fork and South Fork ambient stations, and also before and after the monitoring gap at the South Fork site. All stream segments within these watersheds are Class IV Mountainous Zone Waters, with the exception of the segment between the North Fork Pound Lake and the Town of Pound, which has a Class V(vi) classification as a Stockable Trout Stream.

Table 2.8. Comparison of Select Ambient Parameter Concentrations: 1976-1979 and 2006-2007

Parameter	Units	PNK000.08 (2006-2007)		PNS003.38 (1976-1979)		PNS003.38 (2006-2007)	
		No.	Average	No.	Average	No.	Average
Conductivity	µmhos/cm	10	124.8	0	--	10	1,749.5
Alkalinity	mg/L	10	17.6	15	42.1	10	188.0
Total solids	mg/L	10	86.5	19	678.5	10	1,553.8
Total suspended solids	mg/L	10	4.1	18	242.1	10	3.4
Total nitrogen	mg/L	10	0.2	0	--	10	2.1
Total phosphorus	mg/L	10	0.01	0	--	10	0.01
Chloride	mg/L	9	2.3	1	3.0	10	3.0
Sulfate	mg/L	10	34.5	16	241.4	10	870.2

Plots of monthly ambient water quality monitoring data are shown in Figures 2.6 – 2.22. Monitoring data, when available, were also included from a station further downstream on the Pound River (PNR035.66) to add perspective to the upstream concentrations. Chemical parameters include various forms of nitrogen and phosphorus – ammonia-N, total-N, and total P; various forms of solids – total solids, total dissolved solids (TDS), volatile solids, and suspended solids; alkalinity; manganese; chlorides; and sulfates. Field physical parameters included temperature, pH, dissolved oxygen (DO), and conductivity. Where applicable, minimum and/or maximum water quality standards (WQS) and minimum analytical detection limits (MDL) are indicated on the plots. Assignment of an MDL value indicates that the substance was detected but could not be quantified at lower values due to the precision of the analytical procedure or equipment.

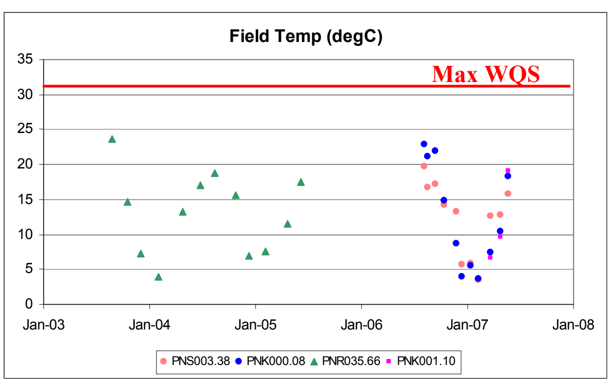

Figure 2.6. Field Temperature

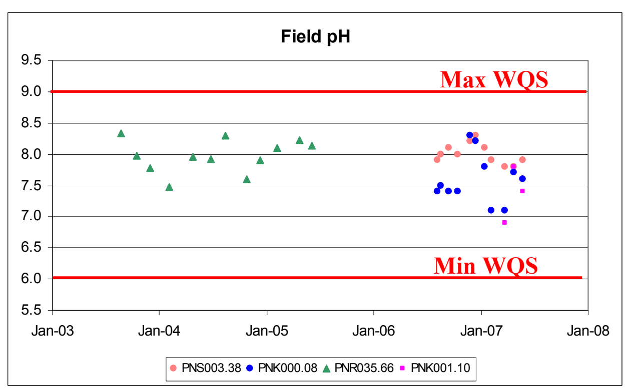

Figure 2.7. Field pH

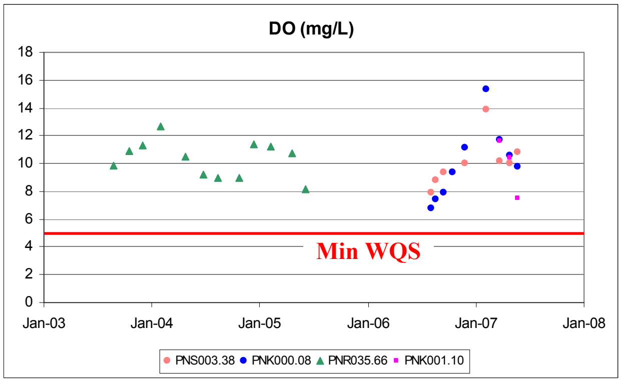

Figure 2.8. Field DO

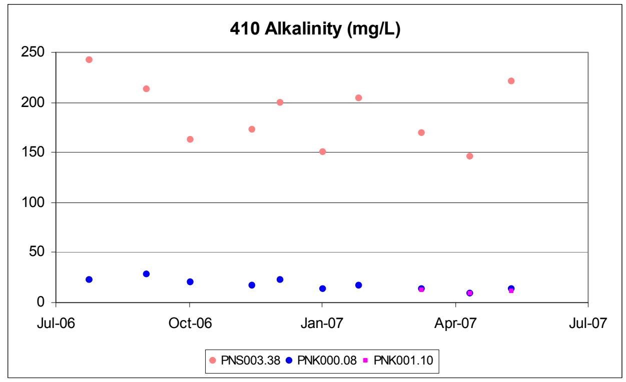

Figure 2.12. Alkalinity

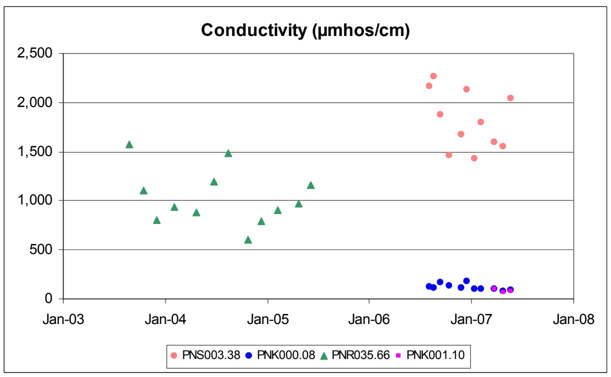

Figure 2.9. Field Conductivity

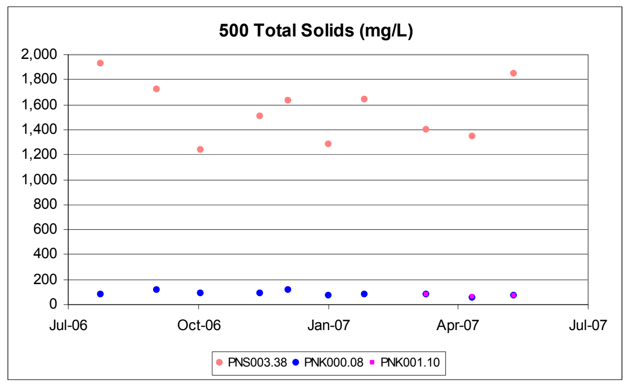

Figure 2.13. Total Solids

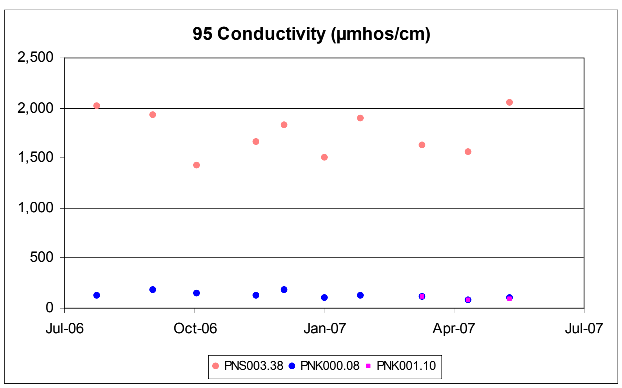

Figure 2.10. Lab Conductivity

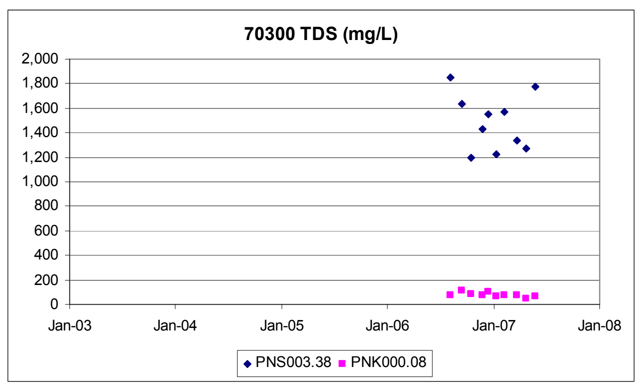

Figure 2.14. Total Dissolved Solids (TDS)

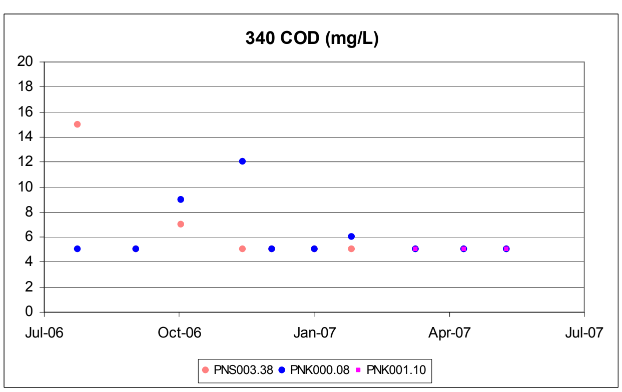

Figure 2.11. Lab COD

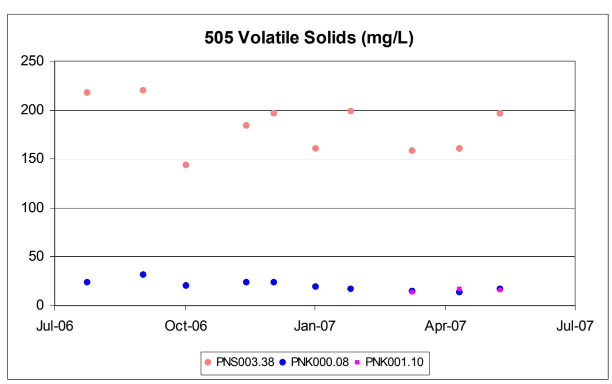

Figure 2.15. Volatile Solids

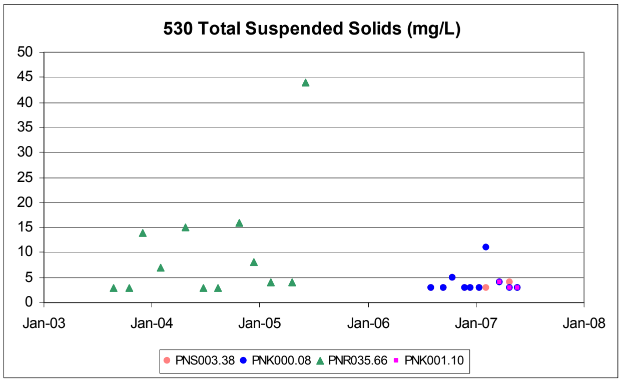

Figure 2.16. Suspended Solids

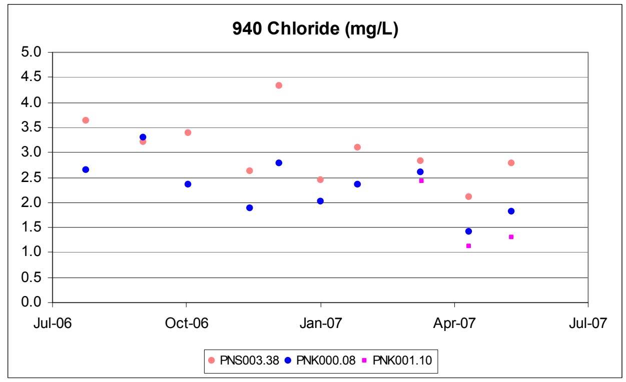

Figure 2.20. Chloride

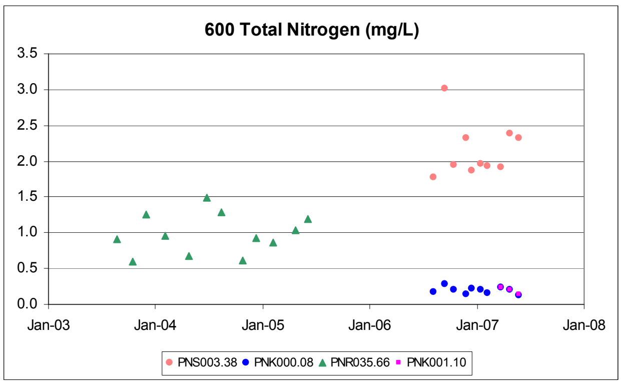

Figure 2.17. Total Nitrogen

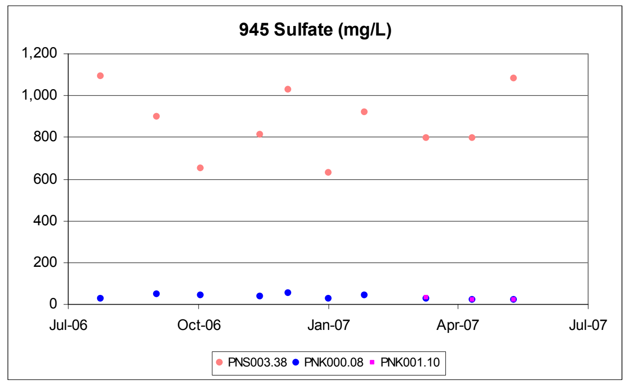

Figure 2.21. Sulfate

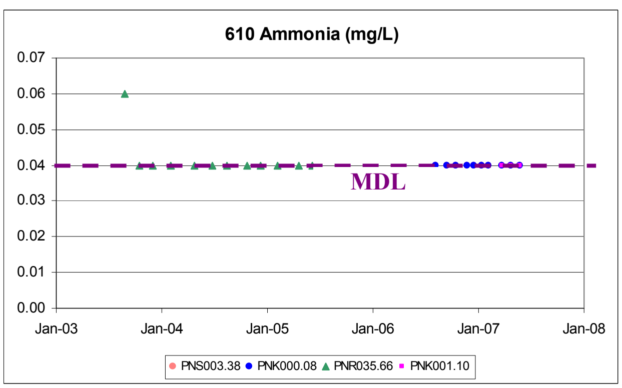

Figure 2.18. Ammonia

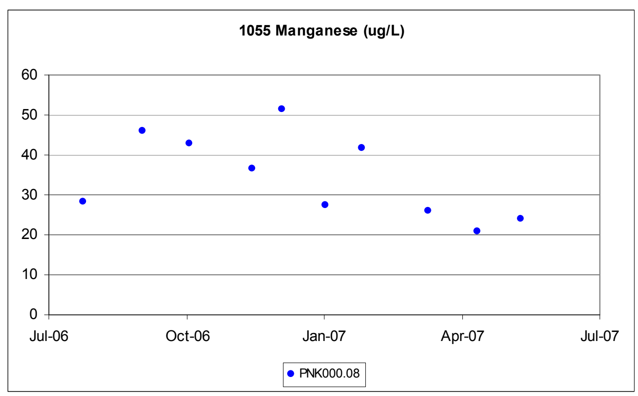

Figure 2.22. Manganese

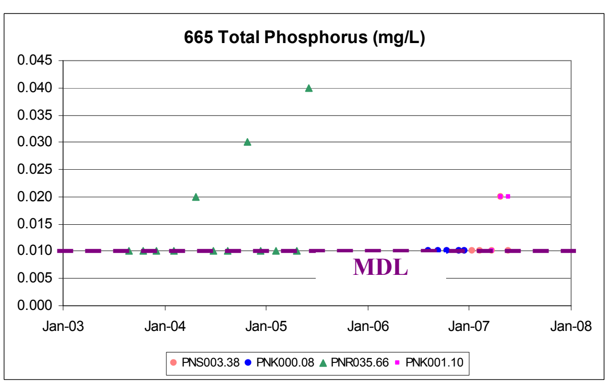

Figure 2.19. Total Phosphorus

The following table (Table 2.9) compares select average nutrient parameter concentrations at each DEQ ambient monitoring station for various periods during the period of record.

Table 2.9. Nutrient Concentration Averages and TN:TP Ratio by Station

Station	Period	No. of Samples	PO4-P (mg/L)	TP (mg/L)	NO2+NO3 (mg/L)	TN (mg/L)	TN/TP
PLL000.09	1972-1976	16	0.076	0.100	0.07	0.20	2.0
PNK000.08	2006-2007	10	0.050	0.011	0.10	0.19	17.6
PNK001.10	2007	3	0.050	0.017	0.11	0.19	11.6
PNS003.94	2001	1		0.010	0.92	1.02	102.0
PNS003.38	2006-2007	10	0.050	0.011	2.07	2.15	195.0

2.1.2. DEQ Stream Metals Data

A varying number of sediment and water column samples have been collected and analyzed for metals at different sites within and downstream from the North Fork and South Fork Pound River watersheds. Some samples consisted of a complete standard suite of metals and toxic substances, while others consisted of a single repeat sample for a specific substance. Since 1979, however, only three sets of samples have been collected in the watershed: PNS003.94 (2001), PNK000.08 (2006), and PNS003.38 (2006).

Most of the substances were not detected above their minimum detection limits, and none of the tested substances exceeded any known freshwater aquatic life or human health criteria, as shown in Table 2.10. One metal – nickel – was detected at levels above it's consensus-based probable effects concentration (MacDonald et al., 2000), once in 2001 and again in 2006 at two different stations, both in the South Fork Pound River watershed.

Table 2.10. DEQ Periodic Channel Bottom Sediment and Water Column Monitoring for Metals, Post-1980

Parameter Name	Pgc Spc Parameter Code	Average Parameter Values Above MDL			Minimum Detection Limit	Consensus-Based PECs	Freshwater Aquatic Life Criteria~		Human Health Criteria~	
		6APNK000.08 10-Aug-06	6APNS003.38 10-Aug-06	6APNS003.94 29-Oct-01			Chronic (ug/L)	Acute (ug/L)	PWS (ug/L)	Other (ug/L)
Channel Bottom Sediment Concentrations (mg/kg)										
CHROMIUM,TOTAL IN BOTTOM DEPOSITS (MG/KG,DRY WGT)	01029	5.9	6.3	6.7		111				
COPPER IN BOTTOM DEPOSITS (MG/KG AS CU DRY WGT)	01043	7.2	8.9	8.0		149				
LEAD IN BOTTOM DEPOSITS (MG/KG AS PB DRY WGT)	01052	7.2	6.9	7.5		128				
MANGANESE IN BOTTOM DEPOSITS (MG/KG AS MN DRY WGT)	01053	900	4,710	2,340						
NICKEL, TOTAL IN BOTTOM DEPOSITS (MG/KG,DRY WGT)	01068	10.3	53.9	52.0		48.6				
ZINC IN BOTTOM DEPOSITS (MG/KG AS ZN DRY WGT)	01093	40.3	127.0	118		459				
ALUMINUM IN BOTTOM DEPOSITS (MG/KG AS AL DRY WGT)	01108	3,680	5,340	5,730						
IRON IN BOTTOM DEPOSITS (MG/KG AS FE DRY WGT)	01170	12,100	19,000	16,500						
MERCURY, SEDIMENT (MG/KG AS HG DRY WT)	71921				0.1	1.06				
Water Column Concentrations (µg/L)										
ALUMINUM, DISSOLVED (UG/L AS AL)	01106	2.0	48.0		1.0					
ARSENIC, DISSOLVED (UG/L AS AS)	01000	0.3	0.2		0.1		150	340	10	
ARSENIC, TOTAL (UG/L AS AS)	01002									
BARIUM, DISSOLVED (UG/L AS BA)	01005	22.2	21.3		10.0				2,000	
CADMIUM, TOTAL (UG/L AS CD)	01027		700							
CHROMIUM, DISSOLVED (UG/L AS CR)	01030		0.2		0.1		74	540	100	
CHROMIUM, TOTAL (UG/L AS CR)	01034		700							
COPPER, DISSOLVED (UG/L AS CU)	01040	0.4	1.7		0.1		9	13	1,300	
COPPER, TOTAL (UG/L AS CU)	01042									
IRON, TOTAL (UG/L AS FE)	01045		1,904.9							
LEAD, TOTAL (UG/L AS PB)	01051		4.0							
MANGANESE, DISSOLVED (UG/L AS MN)	01056	91.2	108.0		0.1				50	
MANGANESE, TOTAL (UG/L AS MN)	01055		2,255.0							
NICKEL, DISSOLVED (UG/L AS NI)	01065	0.5	6.0		0.1		20	180	610	4,600
NICKEL, TOTAL (UG/L AS NI)	01067		700							
SELENIUM, DISSOLVED (UG/L AS SE)	01145		2.8		0.5		5	20	170	11,000
THALLIUM, DISSOLVED (UG/L AS TL)	01057				0.1				1.7	6.3
ZINC, DISSOLVED (UG/L AS ZN)	01090	1.0	5.5		1.0		120	120	9,100	69,000
ZINC, TOTAL (UG/L AS ZN)	01092		101.0							

- potential stressor. PEC = probable effects concentration.

~ 9VAC 25-260 Virginia Water Quality Standards, February 12, 2004.

2.1.3. DMME-DMLR Monitoring Data

DMME-DMLR requires monitoring at the outfall of NPDES sediment ponds and at various in-stream monitoring locations above and below permitted mining areas throughout North Fork and South Fork Pound River watersheds, as shown in Figure 2.23.

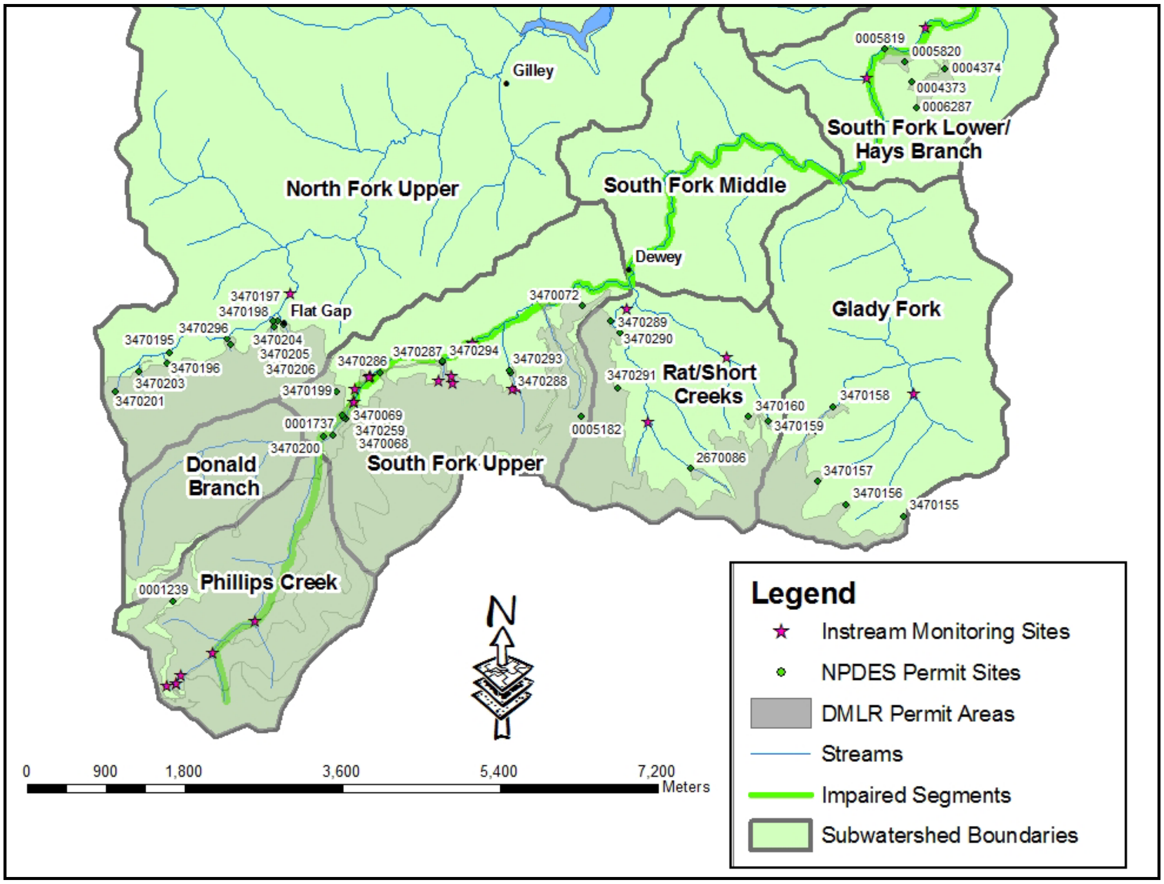

Figure 2.23. DMLR In-stream Monitoring Points in NF and SF Pound River

The average parameter values between January 1996 and December 2006 for the North Fork Pound River DMLR NPDES and in-stream monitoring points are shown respectively in Table 2.11 and Table 2.12; corresponding parameter averages for the South Fork Pound River NPDES and in-stream monitoring points are shown in Table 2.13 and Table 2.14, respectively. The following relative values were used to indicate higher concentrations: conductivity (> 500 µmhos/cm); TDS (> 500 mg/L); and sulfates (> 250 mg/L).

Table 2.11. North Fork Pound River – Active NPDES Monitoring Data

Average Concentrations over Period of Record

DMLR MPID	Flow (gpm)	Depth (feet)	pH	Iron	Manganese	TSS	Temperature (°C)	Acidity	Alkalinity	Conductivity (µmhos/cm)	TDS	Sulfate	Permit Number	Sub-watershed
				(mg/L)				(mg/L)			(mg/L)			
3470195	2.47	--	7.36	0.27	0.23	5.30	--	--	--	--	--	--	1101272	North Fork Upper
3470196	17.35	--	7.59	0.15	0.27	7.38	16.50	--	--	--	--	--	1101272	North Fork Upper
3470197	10.05	7.00	7.44	0.22	0.44	5.31	16.00	--	--	--	--	--	1101272	North Fork Upper
3470198	41.50	--	7.52	0.46	1.46	6.81	16.00	--	--	--	--	--	1101272	North Fork Upper
3470201	0.28	--	7.57	0.10	0.10	7.00	--	--	--	--	--	--	1101272	North Fork Upper
3470203	50.64	--	7.48	0.28	0.69	6.35	16.00	--	--	2,400.0	6,349.2	436.0	1101272	North Fork Upper
3470204	26.61	--	7.50	0.44	1.18	10.14	--	--	--	1,980.1	1,802.7	702.1	1101272	North Fork Upper
3470205	9.46	0.38	7.47	0.39	0.47	7.00	--	--	--	1,172.2	1,011.8	442.4	1101272	North Fork Upper
3470206	16.05	0.47	7.65	0.53	0.36	7.00	--	--	--	1,703.2	1,416.7	606.7	1101272	North Fork Upper
3470296	85.24	--	7.41	0.59	0.33	373.40	--	--	--	960.4	740.9	357.6	1101272	North Fork Upper

Number of Samples over Period of Record

MPID	Flow	Depth	pH	Iron	Manganese	TSS	Temperature	Acidity	Alkalinity	Conductivity	TDS	Sulfate	Permit No.	Sub-watershed
3470195	290	--	73	47	47	47	--	--	--	--	--	--	1101272	North Fork Upper
3470196	280	--	283	15	15	216	2	--	--	--	--	--	1101272	North Fork Upper
3470197	294	1	272	16	17	203	1	--	--	--	--	--	1101272	North Fork Upper
3470198	292	--	293	17	17	218	2	--	--	--	--	--	1101272	North Fork Upper
3470201	279	--	6	1	1	1	--	--	--	--	--	--	1101272	North Fork Upper
3470203	292	--	291	22	22	217	2	5	--	5	5	5	1101272	North Fork Upper
3470204	580	14	580	579	580	7	--	550	7	579	579	578	1101272	North Fork Upper
3470205	589	16	588	588	588	4	--	558	22	588	588	587	1101272	North Fork Upper
3470206	586	15	586	586	586	4	--	579	26	586	586	585	1101272	North Fork Upper
3470296	575	14	575	574	574	5	--	567	20	574	574	574	1101272	North Fork Upper

		pH	Iron	Manganese	TSS	Temperature	Acidity	Alkalinity	Conductivity	TDS	Sulfate
1995-2005	ave.	7.50	0.47	0.60	8.82	16.14	0.00	0.00	1,452.79	1,255.75	518.43
	no.	328	226	227	75	2	414	19	428	428	428
2006	ave.	7.56	0.55	0.35	4.77	--	0.00	--	1,512.64	1,239.37	652.01
	no.	27	18	18	17	0	38	0	38	38	38

- Screening values of Conductivity > 500 µmhos/cm, TDS > 500 mg/L or Sulfate > 250 mg/L.

Table 2.12. North Fork Pound River – Active In-stream Monitoring Data

Average Concentrations over Period of Record

DMLR MPID	Flow (gpm)	Depth (feet)	pH	Iron	Manganese	TSS	Temperature (°C)	Acidity	Alkalinity	Conductivity (µmhos/cm)	TDS	Sulfate	Permit Number	Sub-watershed
				(mg/L)				(mg/L)			(mg/L)			
3420219	124.79	--	7.26	0.68	0.71	11.55	13.37	0.00	87.8	1,137.2	950.8	445.8	1101272	North Fork Upper

Number of Samples over Period of Record

MPID	Flow	Depth	pH	Iron	Manganese	TSS	Temperature	Acidity	Alkalinity	Conductivity	TDS	Sulfate	Permit Number	Sub-watershed
3420219	141	--	141	141	141	141	141	141	141	141	141	141	1101272	North Fork Upper

		pH	Iron	Manganese	TSS	Temperature	Acidity	Alkalinity	Conductivity	TDS	Sulfate
1995-2005	ave.	7.25	0.65	0.72	11.27	13.38	0.00	87.4	1,142.4	963.3	444.2
	no.	132	132	132	132	132	132	132	132	132	132
2006	ave.	7.31	1.02	0.50	15.67	13.22	0.00	93.0	1,060.7	768.6	470.0
	no.	9	9	9	9	9	9	9	9	9	9

- Screening values of Conductivity > 500 µmhos/cm, TDS > 500 mg/L or Sulfate > 250 mg/L.

Table 2.13. South Fork Pound River – Active NPDES Monitoring Data

Average Concentrations over Period of Record

DMLR MPID	Flow (gpm)	Depth (feet)	pH	Iron	Manganese	TSS	Temperature (°C)	Acidity	Alkalinity	Conductivity (µmhos/cm)	TDS	Sulfate	Permit Number	Sub-watershed
				(mg/L)				(mg/L)			(mg/L)			
1239	--	--	--	--	--	--	--	--	--	--	--	--	1101432	Phillips Creek
1737	--	--	--	--	--	--	--	--	--	--	--	--	1101272	South Fork Upper
4373	--	--	--	--	--	--	--	--	--	--	--	--	1101783	South Fork Lower Middle
4374	--	--	6.70	0.10	0.40	31.00	--	--	--	--	--	--	1101783	South Fork Lower Middle
5182	1.30	--	7.23	0.10	0.13	5.00	--	--	--	--	--	--	1101401	South Fork Upper
5819	1.04	--	6.75	--	--	6.00	--	--	--	--	--	--	1101783	South Fork Lower Middle
2670086	43.03	--	7.09	0.29	0.30	6.76	16.33	--	--	--	--	--	1100717	Rat Creek
3470068	52.07	--	7.47	0.22	0.28	6.16	16.00	--	--	--	--	--	1101272	South Fork Upper
3470069	35.10	--	7.45	0.77	0.51	7.70	16.00	--	--	--	--	--	1201187	South Fork Upper
3470072	2.20	--	7.41	0.35	0.91	4.59	--	--	--	--	--	--	1101102	South Fork Upper
3470155	--	--	--	--	--	--	--	--	--	--	--	--	1100717	Glady Fork
3470156	--	--	--	--	--	--	--	--	--	--	--	--	1100717	Glady Fork
3470157	--	--	--	--	--	--	--	--	--	--	--	--	1100717	Glady Fork
3470158	28.07	--	7.79	0.35	0.24	6.65	--	--	--	--	--	--	1100717	Glady Fork
3470159	--	--	--	--	--	--	--	--	--	--	--	--	1100717	Rat Creek
3470160	--	--	--	--	--	--	--	--	--	--	--	--	1100717	Rat Creek
3470199	0.41	--	7.50	0.15	0.45	4.50	--	--	--	--	--	--	1101272	South Fork Upper
3470259	212.94	--	7.41	0.26	0.31	5.85	16.00	--	--	--	--	--	1101272	South Fork Upper
3470286	3.91	--	7.24	0.21	0.78	5.06	--	--	--	--	--	--	1101401	South Fork Upper
3470287	228.82	--	7.61	0.23	1.28	6.55	16.00	--	--	--	--	--	1101401	South Fork Upper
3470288	36.40	--	7.00	0.13	3.69	9.65	16.00	--	--	1,072.5	884.0	501.5	1101401	South Fork Upper
3470289	15.35	--	7.34	0.34	0.31	4.85	--	--	--	--	--	--	1101401	Rat Creek
3470290	3.53	--	7.22	0.21	0.24	5.89	--	--	--	--	--	--	1101401	Rat Creek
3470291	84.24	--	6.97	0.28	0.49	7.25	16.00	--	--	--	--	--	1101401	Rat Creek
3470293	37.16	--	6.49	1.75	4.12	3.00	--	13.90	--	1,964.4	1,838.9	791.5	1101401	South Fork Upper
3470294	231.38	--	7.59	0.30	0.69	2.28	--	--	--	1,948.6	1,704.2	669.7	1101401	South Fork Upper

Number of Samples over Period of Record

MPID	Flow	Depth	pH	Iron	Manganese	TSS	Temperature	Acidity	Alkalinity	Conductivity	TDS	Sulfate	Permit No.	Sub-watershed
1239	269	--	--	--	--	--	--	--	--	--	--	--	1101432	Phillips Creek
1737	181	--	--	--	--	--	--	--	--	--	--	--	1101272	South Fork Upper
4373	64	--	--	--	--	--	--	--	--	--	--	--	1101783	South Fork Lower Middle
4374	73	--	1	1	1	1	--	--	--	--	--	--	1101783	South Fork Lower Middle
5182	77	--	9	3	3	3	--	--	--	--	--	--	1101401	South Fork Upper
5819	24	--	2	--	--	1	--	--	--	--	--	--	1101783	South Fork Lower Middle
2670086	296	--	296	165	165	165	3	--	--	--	--	--	1100717	Rat Creek
3470068	294	--	297	164	164	164	1	--	--	--	--	--	1101272	South Fork Upper
3470069	282	--	201	104	104	104	2	--	--	--	--	--	1201187	South Fork Upper
3470072	246	--	55	16	16	16	--	--	--	--	--	--	1101102	South Fork Upper
3470155	272	--	--	--	--	--	--	--	--	--	--	--	1100717	Glady Fork
3470156	272	--	--	--	--	--	--	--	--	--	--	--	1100717	Glady Fork
3470157	272	--	--	--	--	--	--	--	--	--	--	--	1100717	Glady Fork
3470158	282	--	176	83	83	83	--	--	--	--	--	--	1100717	Glady Fork
3470159	272	--	--	--	--	--	--	--	--	--	--	--	1100717	Rat Creek
3470160	272	--	--	--	--	--	--	--	--	--	--	--	1100717	Rat Creek
3470199	183	--	2	2	2	2	--	--	--	--	--	--	1101272	South Fork Upper
3470259	204	--	194	118	118	118	1	--	--	--	--	--	1101272	South Fork Upper
3470286	285	--	111	54	54	54	--	--	--	--	--	--	1101401	South Fork Upper
3470287	281	--	275	17	16	213	2	--	--	--	--	--	1101401	South Fork Upper
3470288	284	--	267	20	20	208	2	5	--	4	4	4	1101401	South Fork Upper
3470289	280	--	187	73	73	73	--	--	--	--	--	--	1101401	Rat Creek
3470290	276	--	37	9	9	9	--	--	--	--	--	--	1101401	Rat Creek
3470291	286	--	286	110	110	110	2	--	--	--	--	--	1101401	Rat Creek
3470293	534	--	534	534	534	2	--	520	--	520	519	519	1101401	South Fork Upper
3470294	554	--	554	554	553	5	--	539	5	539	539	537	1101401	South Fork Upper

		pH	Iron	Manganese	TSS	Temperature	Acidity	Alkalinity	Conductivity	TDS	Sulfate
1995-2005	ave.	7.21	0.73	1.53	7.03	16.08	7.32	0.00	1,912.4	1,727.8	683.3
	no.	172	108	107	64	2	317	5	316	316	315
2006	ave.	7.57	0.26	0.93	5.33	--	0.00	--	2,480.8	2,274.4	1,317.3
	no.	21	12	12	10	0	38	0	38	38	38

- Screening values of Conductivity > 500 µmhos/cm, TDS > 500 mg/L or Sulfate > 250 mg/L.

Table 2.14. South Fork Pound River – Active In-stream Monitoring Data

Average Concentrations over Period of Record

DMLR MPID	Flow (gpm)	Depth (feet)	pH	Iron (mg/L)	Manganese	TSS	Temperature (°C)	Acidity (mg/L)	Alkalinity	Conductivity (µmhos/cm)	TDS (mg/L)	Sulfate	Permit Number	Sub-watershed
1544	30.33	--	--	--	--	--	--	--	--	--	--	--	1100033	Phillips Creek
4380	5,750.94	--	7.68	0.23	0.31	6.28	14.66	--	150.4	1,198.5	1,137.8	507.5	1101783	South Fork Lower Middle
4381	6,248.13	--	7.63	0.20	0.28	5.46	14.84	--	151.1	1,200.5	1,111.7	509.6	1101783	South Fork Lower Middle
5063	879.29	--	7.66	0.72	0.58	5.46	13.26	--	248.4	2,066.3	1,661.8	702.9	1201383	Phillips Creek
2620125	881.74	--	7.28	0.38	0.45	16.50	12.92	--	61.0	815.8	715.7	317.7	1100033	Phillips Creek
2620126	4,317.62	--	7.80	0.62	0.69	9.75	13.60	--	193.5	1,804.4	1,418.3	616.8	1100033	South Fork Upper
3420066	3,536.65	--	7.73	0.52	0.43	12.00	13.82	--	192.0	1,487.5	1,189.9	545.9	1101272	South Fork Upper
3420084	2,490.70	--	7.73	0.48	0.40	12.00	13.67	--	183.6	1,421.7	1,119.0	495.7	1100520	South Fork Upper
3420085	925.42	--	7.42	0.47	0.36	18.18	13.76	--	122.6	980.2	797.7	380.9	1100520	Phillips Creek
3420109	4,210.50	--	7.80	0.62	0.68	9.89	13.59	--	193.7	1,807.2	1,432.4	618.5	1100787	South Fork Upper
3420110	2,451.99	--	7.72	0.49	0.41	12.16	13.68	--	183.2	1,430.6	1,128.2	495.9	1100787	South Fork Upper
3420111	931.72	--	7.41	0.49	0.36	19.05	13.67	--	125.4	1,003.1	802.6	386.7	1100787	Phillips Creek
3420175	62.09	--	6.84	0.25	0.16	13.50	13.31	--	38.2	1,289.7	1,087.7	541.9	1100717	Rat Creek
3420176	15.20	--	6.04	0.19	0.94	10.07	12.46	8.67	25.7	611.9	481.6	247.6	1100717	Rat Creek
3420177	42.29	--	7.37	0.37	0.46	10.97	13.70	--	100.8	1,071.1	924.7	397.5	1100717	Glady Fork
3420178	140.64	--	7.37	0.53	0.51	10.06	13.27	--	93.8	1,007.6	850.7	376.0	1100717	Glady Fork
3420265	2,532.89	--	7.73	0.48	0.40	12.00	13.73	--	183.6	1,417.7	1,119.0	490.9	1101401	South Fork Upper
3420267	3,169.26	--	7.28	0.35	0.33	15.78	13.33	--	77.4	892.8	664.4	303.5	1101401	Rat Creek
3420268	14.47	--	6.81	1.85	3.40	12.78	13.14	10.60	71.2	1,905.7	1,781.1	777.3	1101401	South Fork Upper
3420269	3.15	--	6.22	9.71	5.19	18.12	12.98	38.59	27.9	1,606.1	1,389.7	595.5	1101401	South Fork Upper
3420270	11.48	--	7.16	1.19	4.19	12.27	13.50	0.33	72.0	1,792.8	1,625.7	673.5	1101401	South Fork Upper
3420271	15.58	--	7.19	0.30	4.11	11.67	13.62	0.04	71.2	1,843.4	1,631.2	689.6	1101401	South Fork Upper
3420272	24.84	--	7.54	0.30	0.42	13.87	13.66	--	174.0	1,925.0	1,660.7	647.6	1101401	South Fork Upper

Number of Samples over Period of Record

MPID	Flow	Depth	pH	Iron	Manganese	TSS	Temperature	Acidity	Alkalinity	Conductivity	TDS	Sulfate	Permit No.	Sub-watershed
1544	141	--	--	--	--	--	--	--	--	--	--	--	1100033	Phillips Creek
4380	32	--	46	46	46	46	32	32	46	46	46	46	1101783	South Fork Lower Middle
4381	32	--	46	46	46	46	32	32	46	46	46	46	1101783	South Fork Lower Middle
5063	35	--	35	35	35	35	35	35	35	35	35	35	1201383	Phillips Creek
2620125	141	--	12	12	12	12	12	12	12	12	12	12	1100033	Phillips Creek
2620126	142	--	142	142	142	142	141	142	142	142	142	141	1100033	South Fork Upper
3420066	452	--	411	410	410	410	410	410	410	411	410	407	1101272	South Fork Upper
3420084	142	--	122	122	122	122	122	122	122	122	122	121	1100520	South Fork Upper
3420085	142	--	137	137	137	137	137	137	137	137	137	136	1100520	Phillips Creek
3420109	143	--	141	141	141	140	140	141	141	141	139	140	1100787	South Fork Upper
3420110	136	--	116	116	116	116	116	116	116	116	116	115	1100787	South Fork Upper
3420111	271	--	258	258	258	257	258	257	257	258	257	255	1100787	Phillips Creek
3420175	141	--	139	139	139	139	138	139	139	139	139	138	1100717	Rat Creek
3420176	141	--	92	92	92	92	91	92	92	92	92	92	1100717	Rat Creek
3420177	141	--	105	105	105	105	105	105	105	105	105	105	1100717	Glady Fork
3420178	141	--	140	140	140	140	140	140	140	140	140	139	1100717	Glady Fork
3420265	142	--	122	122	122	122	121	122	122	122	122	121	1101401	South Fork Upper
3420267	141	--	132	132	132	131	132	132	131	132	132	131	1101401	Rat Creek
3420268	141	--	139	139	139	139	138	139	139	139	139	139	1101401	South Fork Upper
3420269	141	--	59	59	59	59	59	59	59	59	59	59	1101401	South Fork Upper
3420270	218	--	216	216	216	216	216	216	216	216	216	215	1101401	South Fork Upper
3420271	217	--	216	216	216	216	216	216	216	216	216	215	1101401	South Fork Upper
3420272	217	--	217	217	217	217	217	217	217	217	217	216	1101401	South Fork Upper

		pH	Iron	Manganese	TSS	Temperature	Acidity	Alkalinity	Conductivity	TDS	Sulfate
1995-2005	ave.	7.37	0.74	1.18	13.12	13.58	1.62	126.6	1,413.6	1,177.6	504.2
	no.	129	129	129	128	127	127	128	129	128	128
2006	ave.	7.58	0.61	1.53	7.38	13.29	0.24	174.2	1,892.3	1,676.2	940.2
	no.	10	10	10	10	10	10	10	10	10	10

- Screening values of Conductivity > 500 µmhos/cm, TDS > 500 mg/L or Sulfate > 250 mg/L.

DMLR groundwater monitoring locations are shown in Figure 2.24. Average concentrations of monitored groundwater parameters are shown by monitoring point identification number (MPID) for the North Fork and South Fork Pound River sites in Table 2.15 and Table 2.16, respectively.

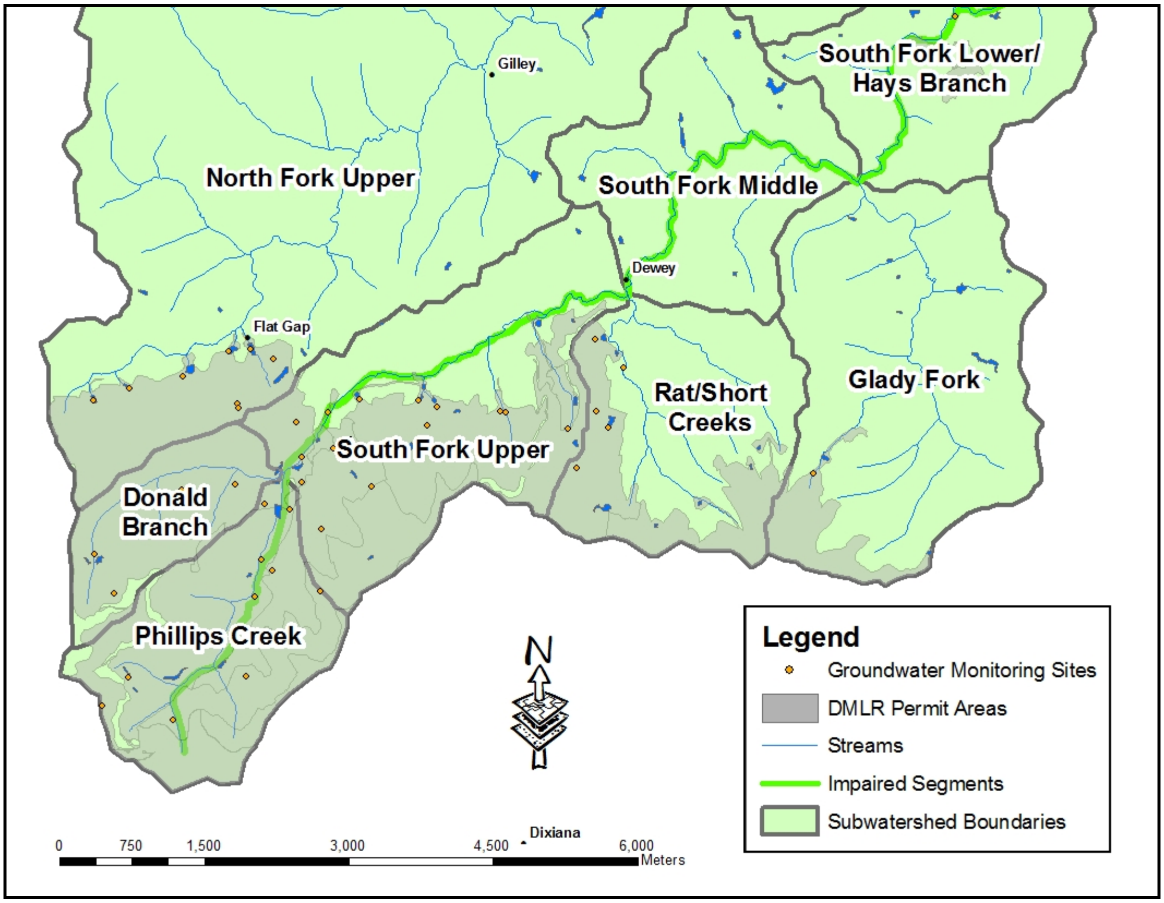

Figure 2.24. DMME-DMLR Active Groundwater Monitoring Sites

Table 2.15. North Fork Pound River – Active Groundwater Monitoring Data

Average Concentrations over Period of Record

DMLR MPID	Flow (gpm)	Depth (feet)	pH	Iron	Manganese	TSS	Temperature (°C)	Acidity	Alkalinity	Conductivity (µmhos/cm)	TDS	Sulfate	Permit Number	Sub-watershed
				(mg/L)				(mg/L)			(mg/L)			
3450208	--	--	--	--	--	--	--	--	--	--	--	--	1101272	North Fork Upper
3450212	1.21	--	7.42	0.28	0.16	5.00	12.34	--	137.1	1,027.3	895.9	453.1	1101272	North Fork Upper
3450213	6.91	--	7.66	1.07	0.35	10.52	13.51	--	146.3	1,675.2	1,424.4	575.9	1101272	North Fork Upper
3450214	4.80	--	7.45	0.33	0.20	6.77	13.42	--	128.3	1,124.1	937.8	393.9	1101272	North Fork Upper
3450215	10.67	--	7.57	0.50	1.69	10.19	13.71	--	113.0	1,999.4	1,879.7	749.3	1101272	North Fork Upper
3450297	9.75	--	7.58	0.52	0.36	7.98	13.70	--	151.2	1,159.3	1,086.3	466.7	1101272	North Fork Upper

Number of Samples over Period of Record

MPID	Flow	Depth	pH	Iron	Manganese	TSS	Temperature	Acidity	Alkalinity	Conductivity	TDS	Sulfate	Permit Number	Sub-watershed
3450208	84	17	--	--	--	--	--	--	--	--	--	--	1101272	North Fork Upper
3450212	271	--	73	13	13	13	73	13	13	73	13	13	1101272	North Fork Upper
3450213	274	--	274	48	48	48	273	48	48	274	48	48	1101272	North Fork Upper
3450214	272	--	258	44	44	44	258	44	44	258	44	44	1101272	North Fork Upper
3450215	273	--	273	47	47	47	273	47	47	273	47	47	1101272	North Fork Upper
3450297	275	--	272	46	46	46	272	46	46	272	46	46	1101272	North Fork Upper

1995-2005	ave.	7.56	0.60	0.64	9.10	13.68	0.00	133.3	1,462.4	1,312.2	518.8
	no.	207	36	36	36	207	36	36	207	36	36
2006	ave.	7.57	0.55	0.44	4.75	11.90	0.00	149.0	1,492.3	1,301.5	759.6
	no.	23	4	4	4	23	4	4	23	4	4

- Screening values of Conductivity > 500 µmhos/cm, TDS > 500 mg/L or Sulfate > 250 mg/L.

Table 2.16. South Fork Pound River – Active Groundwater Monitoring Data

Average Concentrations over Period of Record

DMLR MPID	Flow (gpm)	Depth (feet)	pH	Iron (mg/L)	Manganese	TSS	Temperature (°C)	Acidity (mg/L)	Alkalinity	Conductivity (µmhos/cm)	TDS (mg/L)	Sulfate	Permit Number	Sub-watershed
89	4.12	3.00	7.30	0.67	0.72	16.62	13.10	--	131.4	1,281.3	890.9	422.0	1101401	Rat Creek
936	0.88	--	6.76	0.45	5.54	10.25	12.49	8.50	103.5	1,212.9	1,250.3	509.4	1101401	South Fork Upper
1397	2.02	--	7.72	0.24	0.10	5.00	12.18	--	111.4	1,567.1	1,249.0	388.8	1100520	South Fork Upper
1738	24.31	--	7.43	0.10	0.10	8.00	8.50	--	99.0	1,047.5	714.5	327.0	1101272	South Fork Upper
1770	--	--	--	--	--	--	--	--	--	--	--	--	1201187	South Fork Upper
4375	25.02	50.00	7.23	0.73	0.16	23.91	14.93	--	58.0	596.0	444.5	234.0	1101783	South Fork Lower Middle
4376	0.63	--	7.60	--	--	--	19.00	--	--	650.0	--	--	1101783	South Fork Lower Middle
4377	--	--	--	--	--	--	--	--	--	--	--	--	1101783	South Fork Lower Middle
5061	42.56	--	7.51	0.15	0.03	4.13	10.34	--	202.3	776.4	500.6	210.6	1201383	Phillips Creek
5707	--	88.27	7.24	0.60	0.70	6.00	13.47	--	258.3	1,312.0	1,176.7	430.3	1600876	Phillips Creek
3440273	14.38	5.76	6.83	40.32	2.35	125.35	14.07	--	214.5	1,851.7	1,612.2	669.6	1101272	South Fork Upper
3440274	285.00	--	6.73	0.28	0.07	5.68	16.43	--	86.6	365.4	192.8	36.6	1101401	Rat Creek
3441025	50.00	--	7.10	--	--	--	13.33	--	--	2,000.0	--	--	1100520	Phillips Creek
3450173	9.49	--	7.53	0.44	0.33	11.94	13.40	--	111.1	1,163.5	970.5	403.7	1100717	Glady Fork
3450280	2.03	--	6.89	1.51	4.15	9.05	13.99	14.16	96.5	968.9	887.6	548.4	1101401	South Fork Upper
3450281	13.05	15.00	7.16	0.40	4.93	12.22	13.50	--	80.6	1,903.8	1,928.4	691.6	1101401	South Fork Upper
3450282	20.36	--	7.46	0.29	0.33	7.37	13.52	--	190.3	2,075.9	1,867.1	687.4	1101401	South Fork Upper
3450283	13.12	--	7.04	0.50	2.22	14.47	13.77	3.33	69.1	1,619.2	1,760.8	623.8	1101401	South Fork Upper
3450284	1.83	20.00	6.83	1.28	3.77	31.25	13.09	--	50.9	1,427.7	1,422.1	493.6	1101401	South Fork Upper
3450285	18.90	15.00	4.71	2.18	13.40	12.51	13.55	145.38	5.4	2,903.9	2,663.3	920.3	1101401	Rat Creek
3450316	--	14.37	4.41	0.54	1.73	18.73	12.71	18.91	21.5	299.9	218.3	104.3	1101432	Phillips Creek
3451027	--	--	--	--	--	--	--	--	--	--	--	--	1100520	Phillips Creek
3451032	38.68	--	7.49	0.46	0.38	7.40	13.97	--	151.5	1,196.1	1,132.8	475.2	1100520	South Fork Upper
3451981	--	--	--	--	--	--	--	--	--	--	--	--	1100787	South Fork Upper

Number of Samples During Period of Record

MPID	Flow	Depth	pH	Iron	Manganese	TSS	Temperature	Acidity	Alkalinity	Conductivity	TDS	Sulfate	Permit No.	Sub-watershed
89	264	1	203	34	34	34	203	34	34	203	34	34	1101401	Rat Creek
936	264	--	41	8	8	8	41	8	8	41	8	8	1101401	South Fork Upper
1397	278	--	28	8	8	8	28	8	8	28	8	8	1100520	South Fork Upper
1738	181	--	8	2	2	2	8	2	2	8	2	2	1101272	South Fork Upper
1770	173	--	--	--	--	--	--	--	--	--	--	--	1201187	South Fork Upper
4375	63	1	58	22	22	22	45	9	22	58	22	22	1101783	South Fork Lower Middle
4376	40	13	1	--	--	--	1	--	--	1	--	--	1101783	South Fork Lower Middle
4377	40	13	--	--	--	--	--	--	--	--	--	--	1101783	South Fork Lower Middle
5061	39	--	39	8	8	8	38	8	8	39	8	8	1201383	Phillips Creek
5707	--	45	45	7	7	7	45	7	7	45	7	7	1600876	Phillips Creek
3440273	330	903	972	156	156	156	962	156	156	972	156	156	1101272	South Fork Upper
3440274	2	1	280	47	47	47	280	47	47	280	47	46	1101401	Rat Creek
3441025	3	--	3	--	--	--	3	--	--	3	--	--	1100520	Phillips Creek
3450173	283	--	209	35	35	35	209	35	35	209	35	35	1100717	Glady Fork
3450280	273	--	107	19	19	19	107	19	19	107	19	19	1101401	South Fork Upper
3450281	268	1	264	45	45	45	263	45	45	264	45	45	1101401	South Fork Upper
3450282	252	--	250	43	43	43	250	43	43	250	43	43	1101401	South Fork Upper
3450283	274	--	270	45	45	45	268	45	45	270	45	45	1101401	South Fork Upper
3450284	265	3	102	16	16	16	102	16	16	102	16	16	1101401	South Fork Upper
3450285	281	1	281	47	47	47	280	47	47	281	47	47	1101401	Rat Creek
3450316	109	240	57	11	11	11	55	11	11	57	11	11	1101432	Phillips Creek
3451027	86	67	--	--	--	--	--	--	--	--	--	--	1100520	Phillips Creek
3451032	275	--	274	47	47	47	273	47	47	274	47	47	1100520	South Fork Upper
3451981	264	--	--	--	--	--	--	--	--	--	--	--	1100787	South Fork Upper

		pH	Iron	Manganese	TSS	Temperature	Acidity	Alkalinity	Conductivity	TDS	Sulfate
1995-2005	ave.	6.84	11.33	2.54	43.43	13.94	13.03	125.3	1,549.1	1,362.0	510.1
	no.	152	29	29	29	150	29	29	152	29	29
2006	ave.	6.95	7.51	3.98	20.73	13.15	10.71	173.2	1,877.0	1,704.7	905.2
	no.	23	4	4	4	23	4	4	23	4	4

- Screening values of Conductivity > 500 µmhos/cm, TDS > 500 mg/L or Sulfate > 250 mg/L.

Point Source Permits

2.1.4. DEQ – VPDES Permit Summary

There are four general discharge permits for single-family homes in the watersheds, as shown in Figure 2.25. There are currently no active VPDES permits for construction or industrial stormwater in either watershed.

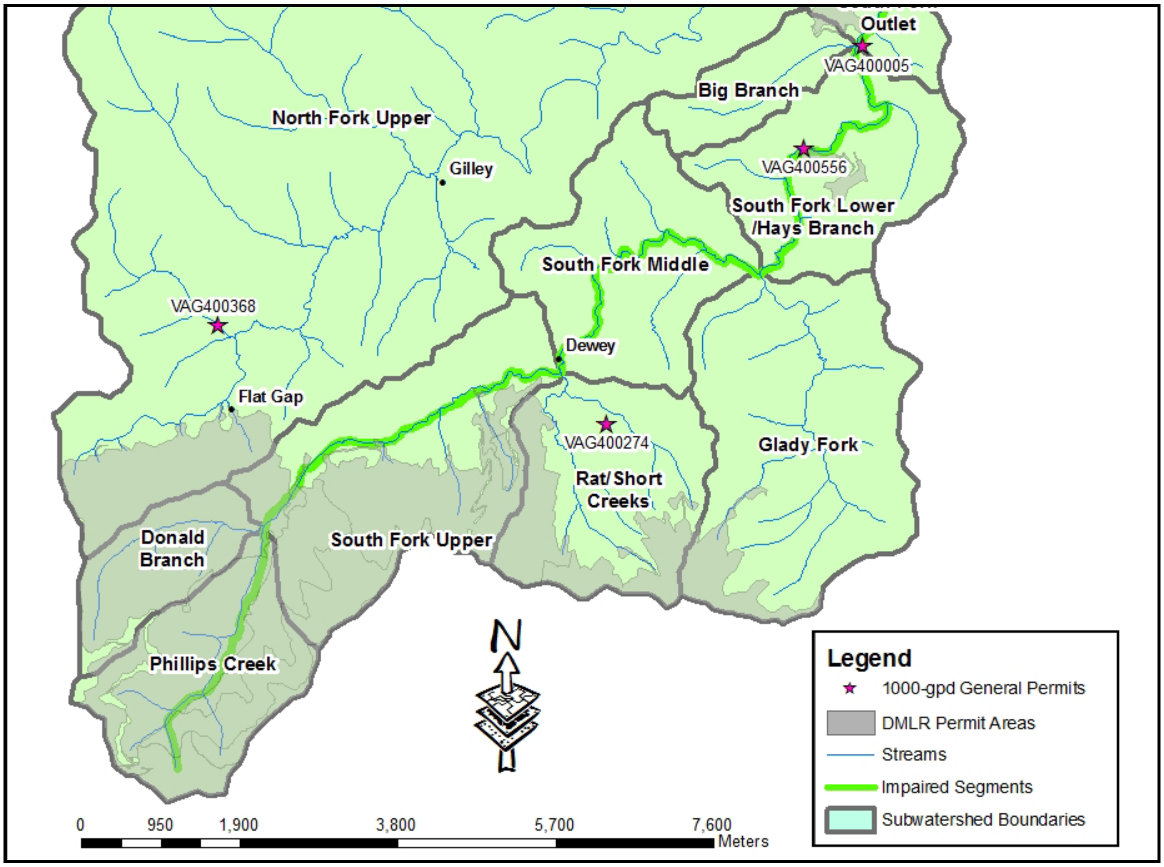

Figure 2.25. DEQ Permitted Point Source Dischargers

2.1.5. DMLR – NPDES Permit Summary

The National Pollutant Discharge Elimination System (NPDES) is a federal program designed to eliminate stormwater pollutant discharges to receiving waters of the United States. The Virginia Department of Mines, Minerals, and Energy's Division of Mined Land Reclamation (DMLR) is responsible for monitoring NPDES discharges for mining permits in Virginia. A summary of the various coal mining permits is given in Table 2.17. Each mining permit will carry various requirements for monitoring their operations. Each permitted area will channel stormwater runoff through an NPDES sediment pond, although a pond may serve more than one permitted area. In-stream monitoring and groundwater monitoring are less permit-specific, so that each monitoring location may serve as compliance for multiple upstream permitted areas.

Table 2.17. DMLR Mining Permit Area Summary in North Fork and South Fork Pound River Watersheds (acres), June 2007

Permit Number	Company Name	North Fork Upper	Big Branch	South Fork Lower	South Fork Lower Middle	Glady Fork	Rat Creek	South Fork Upper	Donald Branch	Phillips Creek	Total
1100033	FOX GAP MINE							5.6		78.7	84.3
1100044	STEER BRANCH PREP PLANT-#2 STRIP						1.3	0.8			2.1
1100520	H.E. #1 MINE							194.2		147.9	342.1
1100717	BUCK KNOB MINE					188.1	217.0				405.1
1100787	UPPER PHILLIPS CREEK MINE							215.0		222.9	437.9
1101102	MINE #2							46.3			46.3
1101270	FOUR LANE PERMIT		8.7	41.1							49.9
1101272	FLAT GAP MINE	493.8						112.1	558.5	23.0	1187.4
1101401	NORTH FOX GAP SURFACE MINE						253.9	538.9			792.8
1101565	HIGH SPLINT SURFACE MINE #2								16.6	92.5	109.1
1101760	BACKBONE RIDGE SURFACE MINE									143.2	143.2
1201187	PHILLIPS CREEK DEEP MINE							15.7			15.7
1201338	STILLHOUSE BRANCH MINE							31.2			31.2
1201664	PARSONS #1 MINE									0.9	0.9
1501778	STRAIGHT FORK SURFACE MINE									1.6	1.6
1600876	WEST PHILLIPS CREEK MINE							0.6	8.7	477.0	486.2
1601939	CENTURION MINE				40.6						40.6

2.1.6. DMME's Division of Gas & Oil (DGO) – Permit Summary

Gas and oil permits are issued for construction of gas and oil well pumping facilities. Contributions from gas and oil operations in the watershed are transient, and regulations require that any disturbed acreage during construction and drilling must be stabilized within 30 days. Sediment loads from both the pumping sites and the access roads are covered under the permits, unless existing roads are used for access.

A summary of the current active well and plugged release well permits in the area are shown in Table 2.18. Currently there are 30 active wells in the watershed with an additional 16 wells permitted that have not yet been constructed. These gas and oil well locations are shown in Figure 2.26.

Table 2.18. DMME Division of Gas and Oil (DGO) Well Permit Summary

Permit No.	Operation ID	Company Name	County	USGS Quad	Sub-watershed	Operation Description	Permit Status Description
Active Wells							
WS-0296	VP133805	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas	Producing
WS-0426	V-3140	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas	Producing
WS-0487	V-3400	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas	Producing
WS-0571	V-4200	Equitable Production Company	WISE	FLAT GAP	RUMLEY BRANCH	Gas	Producing
WS-0573	V-4199	Equitable Production Company	WISE	FLAT GAP	BEAR BRANCH	Gas	Producing
WS-0574	V-4286	Equitable Production Company	WISE	FLAT GAP	BEAR CREEK	Gas	Producing
WS-0575	V-4320	Equitable Production Company	WISE	FLAT GAP	BAD BRANCH	Gas	Producing
WS-0576	V-4288	Equitable Production Company	WISE	FLAT GAP	RUMLEY BRANCH	Gas	Producing
WS-0578	V-4319	Equitable Production Company	WISE	FLAT GAP	RUMLEY BRANCH	Gas	Producing
WS-0579	V-4198	Equitable Production Company	WISE	FLAT GAP	BEAR FORK	Gas	Producing
WS-0580	V-4318	Equitable Production Company	WISE	FLAT GAP	RUMLEY BRANCH	Gas	Producing
WS-0583	VP-4287 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	RUMLEY BRANCH	Gas	Producing
WS-0585	V-4285	Equitable Production Company	WISE	FLAT GAP	BEAR FORK	Gas	Producing
WS-0491	V-3607 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas/Pipeline	Producing
WS-0506	V-3686 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas/Pipeline	Producing
WS-0524	V-3831 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas/Pipeline	Producing
WS-0536	V-3833 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas/Pipeline	Producing
WS-0539	V-3801 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas/Pipeline	Producing
WS-0540	V-3803 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas/Pipeline	Producing
WS-0541	V-3802 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas/Pipeline	Producing
WS-0554	V-3832 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	BEAR CREEK	Gas/Pipeline	Producing
WS-0588	V-4358 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas/Pipeline	Producing
WS-0589	V-4572 W/Pipeline	Equitable Production Company	WISE	FLAT GAP	RUMLEY BRANCH	Gas/Pipeline	Producing
WS-0591	V-4571 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	RUMLEY BRANCH	Gas/Pipeline	Producing
WS-0592	V-4289 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas/Pipeline	Producing
WS-0636	V-505027 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	CUMBERLAND RIVER	Gas/Pipeline	Producing
WS-0638	V-502795 W/Pipeline	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas/Pipeline	Producing
WS-0502	V-3665	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Gas	Shut In
WS-0465	V-3199	Equitable Production Company	WISE	FLAT GAP	PHILLIPS CREEK	Gas	Producing
WS-0489	V-3609	Equitable Production Company	WISE	FLAT GAP	PHILLIPS CREEK	Gas	Producing
WS-0494	VAD-2839	Equitable Production Company	WISE	FLAT GAP	GLADY FORK	Gas/CB Dual Completion	Producing
Plugged Released Wells							
WS-0516	VC-3136 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Coalbed/Pipeline	Plugged/Abandoned
WS-0526	VC-3813 W/PIPELINE	Equitable Production Company	WISE	FLAT GAP	North Fork Upper	Coalbed/Pipeline	Plugged/Abandoned
WS-0043	10001	Wise Oil & Gas	WISE	FLAT GAP	North Fork Upper	Gas	Plugging/Plugged/Abandoned
WS-0001	VP133501	Equitable Production Company	WISE	FLAT GAP	Phillips Creek	Gas	Released
WS-0459	V-3199	EQUITABLE PRODUCTION COMPANY	WISE	FLAT GAP	South Fork Upper	Gas	Plugging/Plugged/Abandoned
WS-0007	163	Clinchfield Coal Co	WISE	POUND	Glady Fork	Gas	Plugging/Plugged/Abandoned

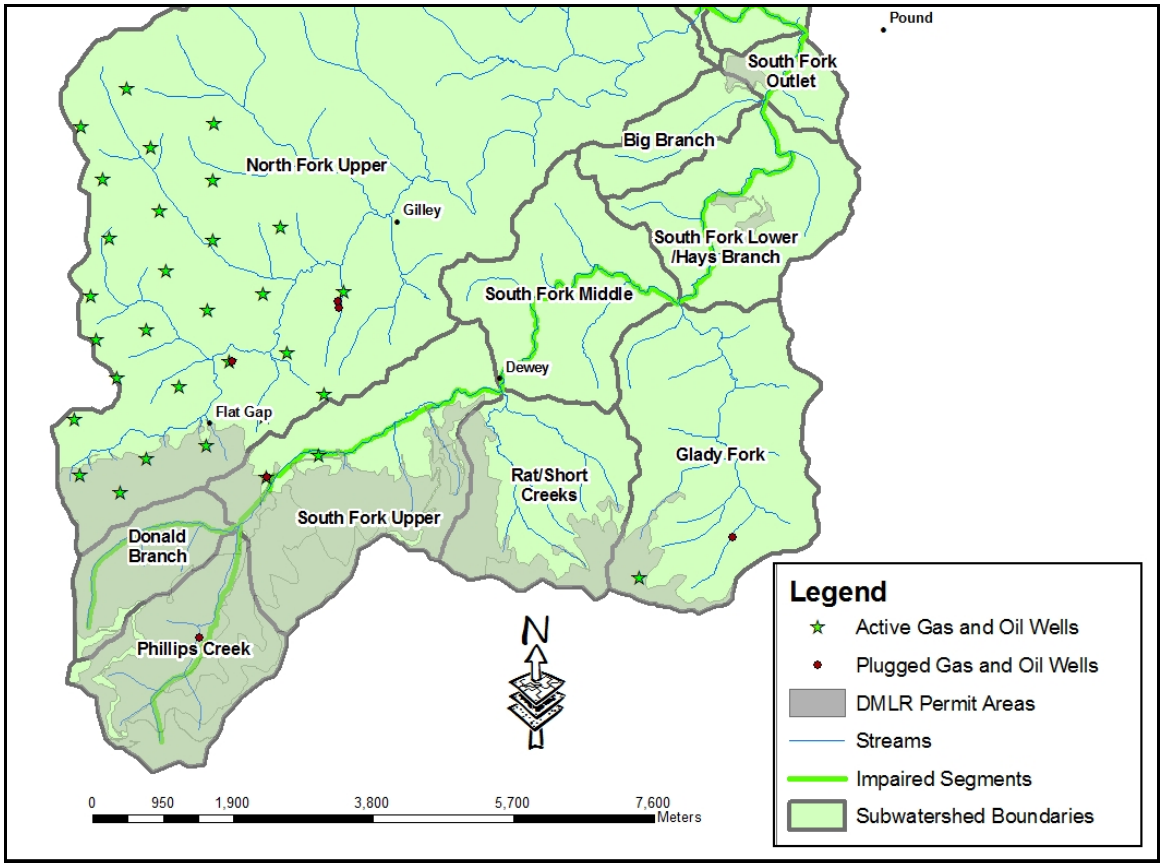

Figure 2.26. DMME DGO Gas Well Locations

A summary of all DMME permits in the area encompassing the impaired segments and their related drainage are shown by sub-watershed in Table 2.19. The sub-watershed location map was shown previously in Figure 2.3. Because of the recent flurry of activity surrounding the energy-producing industry, it is anticipated that up to 600 new gas and oil wells may be slated for Wise County in the coming years. Reclaimed areas not in other uses might be prime target areas for these applications.

Table 2.19. Summary of DMME Permits and Monitoring Sites in NF and SF Pound River with Monitored Data, 1995-2006

Type of DMME Permits/Monitoring	Upper North Fork	**Lower North Fork**	**South Fork**	**Donald Branch**	**Phillips Creek**	**TMDL Watersheds Totals**
DGO Active Wells	28	0	3	0	0	**3**
DGO Plugged Release Wells	3	0	2	0	1	**3**
DMLR NPDES Discharging Outfalls	10	0	28	0	1	**29**
DMLR Instream Monitoring Sites	1	0	18	0	5	**23**
DMLR Groundwater Monitoring Sites	6	0	28	1	5	**34**

<u>Ancillary Data</u>

2.1.7. 305(b) Monitored Exceedences

In all four biennial reports between 1998 and 2004 (VADEQ, 1998, 2000, 2002, 2004), no standards exceedences of temperature, pH, or DO were reported for any of the North Fork and South Fork Pound River stations, as shown in Table 2.20 below.

One exceedence of the consensus-based probability effects concentration (PEC) was noted in the South Fork Pound River for Nickel in bottom sediments in the 2004 assessment, based on a sample in October 2001. A second exceedence of the consensus-based PEC was also noted in a sample taken at the same site in August 2006 that is not reflected in the table.

Table 2.20. 305(b) Monitored Exceedences

				CONVENTIONAL WATER COLUMN MONITORING DATA			**OTHER WATER COLUMN DATA**				**SEDIMENT**		**BENTHIC**		
				#Violations/# Samples/Status			#Violations/# Samples/Status				#Violations/Status				
Year	**WBID**	**Monitoring Station**	**Type**	**Temperature**	**Dissolved Oxygen**	**pH**	**Fecal Coliform**	**Total Phosphorus**	**Chlorophyll A**	**Organics**	**Metals**	**Organics**	**Bio Mon**	**Station Type**	**Comments**
1998	**S-Q13R**	**6APNK000.08**	B	/	/	/	/	/	/				**MI**	net	
1998	**S-Q13R**	**6APNS000.40**	B	/	/	/	/	/	/				**VI**	net	
2000	**S-Q13R**	**6APNK000.08**	B	/	/	/	/	/	/				**MI**	net	
2000	**S-Q13R**	**6APNS000.40**	B	/	/	/	/	/	/				**VI**	net	
2002	**S-Q13R**	**6APNK000.08**	B	0 / 4 S	0 / 4 S	0 / 4 S	/	/	/				**MI**	net	
2002	**S-Q13R**	**6APNS000.40**	B	0 / 4 S	0 / 4 S	0 / 4 S	/	/	/				**MI**	net	
2002	S-Q13R	6APNS004.98	B	0 / 0 W	0 / 0 W	0 / 0 W	/	/	/				T	net	additional monitoring needed
2002	**S-Q13R**	**6APNS008.73**	B	0 / 0 W	0 / 0 W	0 / 0 W	/	/	/				**VI**	net	
2004	**S-Q13R**	**6APLL000.17**	B										**NI**		
2004	**S-Q13R**	**6APNK000.08**	A,B	0 / 2 S	0 / 2 S	0 / 2 S							**MI**		
2004	**S-Q13R**	**6APNS000.40**	B	0 / 2 S	0 / 2 S	0 / 2 S							**MI**		
2004	S-Q13R	6APNS003.94	FPM	0 / 1 W	0 / 1 W	0 / 1 W	1 / 1 W				1 O		SI		Ni in sed 52.00
2004	**S-Q13R**	**6APNS004.98**	B										**MI**		
2004	**S-Q13R**	**6APNS008.73**	B										**VI**		
2006		**None Listed**													

Bold/Shaded = Impaired Waters
Pink = Threatened Waters / Observed Effects

2.1.8. DCR Watershed NPS Pollutant Load Ratings

DCR performs a biennial assessment of NPS pollutant loads for each of the state's 493 14-digit hydrologic units (DCR, 2004). All of the North Fork and South Fork Pound River impaired segments are within the Q13 hydrologic unit, and more specifically, the BS28 watershed in the National Watershed Boundary Dataset. The NPS pollutant load ratings for Q13 are shown in Table 2.21.

This NPS pollutant potential assessment ranks urban and forestry land uses in this hydrologic unit with high potential for sediment, N, and P loading. In this classification, urban land uses include mining.

Table 2.21. DCR Watershed NPS Pollutant Ratings – Q13

Watershed-ID	Year	AGR_N	AGR_P	AGR_S	URB_N	URB_P	URB_S	FOR_N	FOR_P	FOR_S	TOT_N	TOT_P	TOT_S	RIMP	EIMP	LIMP	SWP	IBI
Q13	2006	L	L	L	H	H	H	H	H	H	L	M	M	L	N	L	D	D
Q13	2004	L	L	L	M	H	H	H	H	H	L	M	L	L	N	L	D	D
Q13	2002	L	L	L	M	H	H	H	H	H	L	M	L	L	N	L	D	D
Q13	2000	L			L			L			L	--	--	M	N	--	--	--

Header Codes
AGR - agriculture
URB - urban
FOR - forestry
N - nitrogen
P - phosphorus
S - sediment
RIMP - Riverine Impairments
EIMP - Estuarine Impairments
LIMP - Lacustrine Impairments

Nutrient & Impairment Rank Codes
H - High
M - Medium
L - Low
N - Not Applicable

SWP - Source Water Protection Codes
A - Very High
B - High
C - Moderate
D - Low
E - None

IBI - miniMIBI Codes
A: 16-24/5
B: 16-24/1-3
C: 13-15
D: 1-12
E: Insufficient Data

CHAPTER 3: BENTHIC STRESSOR ANALYSIS

Introduction

TMDLs must be developed for a specific pollutant. Since a benthic impairment is based on a biological inventory, rather than on a physical or chemical water quality parameter, the pollutant is not explicitly identified in the assessment, as it is with physical and chemical parameters. The process outlined in USEPA's Stressor Identification Guidance Document (USEPA, 2000) was used to identify the critical stressor for the three impaired segments in the North Fork and South Fork Pound River watersheds (Lower North Fork Pound River, VAS-Q13R-02; Phillips Creek, VAS-Q13R-04; and the South Fork Pound River, VAS-Q13R-01). A list of candidate causes was developed from the listing information, biological data, published literature, and stakeholder input. Chemical and physical monitoring data from DEQ monitoring provided additional evidence to support or eliminate the potential candidate causes. Biological metrics and habitat evaluations in aggregate provided the basis for the initial impairment listing, but individual metrics were also used to look for links with specific stressors, where possible. Volunteer monitoring data, land use distribution, Virginia Base Mapping Project (VBMP) aerial imagery, and visual assessment of conditions in and along the stream corridor provided additional information to investigate specific potential stressors. Logical pathways were explored between observed effects in the benthic community, potential stressors, and intermediate steps or interactions that would be consistent in establishing a cause and effect relationship with each candidate cause. The candidate benthic stressors considered in the following sections are ammonia, hydrologic modifications, nutrients, organic matter, pH, sediment, TDS, conductivity, sulfates, temperature, and toxics. The information in this section is adapted from the Stressor Analysis Report for North Fork and South Fork Pound River (Yagow et al., 2007a).

Depending on the weight of evidence available, each potential stressor was placed into one of the following three categories:

- Eliminated Stressors: Potential stressors with data indicating normal conditions, without violations of a governing standard, or without observable impacts usually associated with a specific stressor. These stressors were eliminated from the list of possible stressors.
- Possible Stressors: Stressors with data indicating possible links, but with inconclusive data, were considered to be possible stressors.
- Most Probable Stressor(s): Stressor(s) with the most consistent data linking it with the poorer benthic metrics, or the most plausible of the possible stressors. This stressor(s) was selected as the most probable stressor(s) and was used for TMDL development.

The results of the analysis on each of the three impaired segments are given in the next three sections.

Analysis of Candidate Stressors for North Fork Pound River

The purpose of the stressor analysis is to look for a stressor that was present in the April 1993 – March 1995 period, which caused North Fork Pound River's initial 1996 listing on the impaired waters list. The stressor may be something that either directly affected the benthic community or indirectly affected its habitat. Virginia SCI ratings suggest that the benthic community has been alternately slightly stressed and non-impaired at different times during the period from 1990 to 2006.

A list of candidate stressors was developed for North Fork Pound River and evaluated to determine the pollutant(s) responsible for the benthic impairment. A potential stressor checklist was used to evaluate known relationships or conditions that may show cause and effect between potential stressors and changes in the benthic community. An outline of available evidence was then summarized as the basis for each potential stressor. Candidate stressors included ammonia, hydrologic modifications, nutrients, organic matter, pH, sediment, TDS, conductivity, sulfates, temperature, and toxics. The evaluation of each candidate stressor is discussed in the following sections.

3.1.1. Eliminated Stressors

Ammonia

High values of ammonia are toxic to many fish species and may impact the benthic community as well. All the values recorded at PNK000.08 were at or below the minimum detection limit (MDL) of 0.04 mg/L. No fish kills have been reported in this watershed and nothing in the ambient monitored data indicated ammonia as a stressor, therefore it was eliminated from further consideration as a stressor for North Fork Pound River.

Nutrients

Excessive nutrient inputs can lead to excessive algal growth, eutrophication, and low dissolved oxygen concentrations which may adversely affect the survival of benthic macro-invertebrates. In particular, dissolved oxygen levels may become low during overnight hours due to plant respiration. The majority of DEQ-monitored dissolved phosphorus concentrations have been at or below their minimum analytical detection limit at all stations and, therefore, the segment has never exceeded DEQ's "threatened waters" threshold. The average total nitrogen concentrations are among the lowest of all DEQ ambient stations.

While the benthic community in the North Fork Pound River has been occasionally dominated by Chironomidae or Hydropsychidae or Simuliidae – organisms associated with excessive nutrients, it has also been frequently dominated by pollution-sensitive (Tolerance Values = 2-4) organisms. Low riparian vegetation scores have been recorded over time in the habitat metrics, which could promote increased nutrient transport through surface runoff. However, the very low monitored in-stream nutrient concentrations argue against this source. Therefore, nutrients have been eliminated as a possible stressor.

pH

Benthic macro-invertebrates require a specific pH range of 6.0 to 9.0 to live and grow. Changes in pH may adversely affect the survival of benthic macro-invertebrates. Treated wastewater and urban runoff can potentially alter in-stream levels of pH. No exceedence of the minimum or maximum pH standard occurred in at either of the stations on the impaired segment. Therefore, pH would be an unlikely source of stress and it was eliminated from further consideration as a stressor.

TDS

Total dissolved solids (TDS) consist primarily of dissolved salts (ionized substances) plus dissolved metals, minerals and organic matter. Electrical conductivity is a measure of the ability of a solution to carry a current based on the concentration of ionized substances dissolved in the water, and so has a direct correlation with TDS. Since each type of ion has a different ability to conduct electricity, however, conductivity will not be directly equivalent to TDS, as conductivity strength will depend on the composition of ions in the TDS sample. The major components of TDS are calcium, magnesium, potassium, sodium, bicarbonate, chlorides, and sulfates. Since sulfates are a component of TDS, and since conductivity is closely related to TDS, these three parameters were considered together as a possible stressor. Sources of TDS include mining operations, raw sewage, road salts, irrigation water, and improper discharge or treatment of water softening compounds. Virginia has no surface water quality standards for any of these, though it does have taste and odor criteria for public drinking water supplies of 500 mg/L for TDS and 250 mg/L for sulfates. These values along with a conductivity concentration of 500 µmhos/cm have been used as screening values to denote elevated concentrations.

The average TDS, conductivity, and sulfate concentrations in the headwaters of North Fork Pound River watershed monitored by DMLR were found to be greater than their respective screening values for the samples analyzed from NPDES ponds, in-stream, and groundwater monitoring. However, recent DEQ monitoring in 2006 and 2007 along the impaired segment has recorded conductivity and sulfate concentrations below the screening values and between one and two orders of magnitude smaller than in the mined headwaters. Therefore, TDS and its related parameters do not appear to be stressors in this portion of the watershed and have been eliminated as possible stressors.

<u>Toxics</u>

Although several biological samples in spring 1994 and spring 1998 have reported low numbers of total organisms, there have been no reports of fish kills or exceedences of any known aquatic life or human health criteria. While mining has occurred in the headwaters of North Fork Pound River, the relative percentage of mined area is minor and the distance between this potential source and the outlet is fairly large and separated by the North Fork Pound Lake. Hence toxics were eliminated as a stressor to benthic community in the impaired segment of the North Fork Pound River.

3.1.2. Possible Stressors

<u>Hydrologic Modifications</u>

Hydrologic modifications can cause shifts in the supply of water, sediment, food supply, habitat, and pollutants from one part of the watershed to another, thereby causing changes in the types of biological communities that can be supported by the changed environment. The headwaters of the North Fork Pound River watershed have been intensively mined, though they are separated by a long distance and by an impoundment from the downstream impaired segment. The North Fork Pound Lake is a hydrologic modification that undoubtedly had an impact on the downstream community. Buildings in the outskirts of Pound are crowded into the riparian corridor along the impaired segment, and the lake discharge is controlled between October and December in order to draw down the lake and increase storage capacity for protection against spring floods. While all these modifications have undoubtedly created stress in the impaired segment, most of the re-adjustment was expected to have occurred prior to the declared impairment, though with the many unknowns and sparse data, hydrologic modifications are considered a possible stressor.

<u>Organic Matter</u>

Excessive organic matter can lead to low in-stream dissolved oxygen concentrations which may adversely affect the survival and growth of benthic macro-invertebrates. Potential sources of organic matter in the impaired North

Fork Pound River segment include household wastewater discharges, malfunctioning septic systems, and runoff from impervious areas. Most of the watershed is sewered, so the septic system load is expected to be minor. High values of the modified family biotic index (MFBI) metric recorded on several occasions at PNK000.08 are indicative of organic-enriched streams. Organic enrichment is also supported by the types of dominant benthic organisms found in many of the samples – Hydropsychidae and Simuliidae – typical of organic-enriched sites, and the low ratios of scrapers to filterer-collectors, indicative of abundant suspended organic matter used as a food source for the filterer-collectors. However, no problems were monitored with DO depletion, and another organic measurement – COD – was also at minimal levels. Therefore, while organic matter is considered to be a possible stressor, it is unlikely to have been a major source of stress.

Temperature

North Fork Pound River is classified as a Class V mountain stream with a maximum temperature standard of 21°C. The riparian vegetation in North Fork Pound River has received poor scores on some occasions and the temperature of water at the outlet of North Fork Pound River has exceeded the standard during all available summer measurements (3 samples in 2006, 2 samples in 2007). Therefore, temperature appears to be a possible stressor for fish, although its impact on the benthic community in North Fork Pound River is expected to be minimal.

3.1.3. Most Probable Stressor

The most probable stressor to the benthic community for this minor impairment on the North Fork Pound River is considered to be sediment, based on the following summary of available evidence.

Sediment

Excessive sedimentation can impair benthic communities through loss of habitat. Excess sediment can fill the pores in gravel and cobble substrate, eliminating macro-invertebrate habitat. Potential sources of sediment include agricultural and residential runoff, forestry and mining operations, construction sites, in-stream disturbances, and lake discharge. Although most of the biological samples contained a good proportion of Haptobenthos, which requires clean substrates, sediment is supported as a stressor for this minor impairment through the poor habitat metrics related to sediment including bank stability, embeddedness, riparian vegetation, and sediment deposition. Point sources are not present in the drainage to this segment and agricultural sources are sparse. Ambient TSS concentrations are low, but no runoff samples have been analyzed for NPS sediment, which is suspected. Therefore, sediment problems appear to be related to barren areas in the watershed that are subject to soil detachment, runoff from impervious areas, and possibly from lake discharge. Barren areas include recently cleared forested areas, new construction, and poorly vegetated riparian areas along streams. Because the impairment is relatively minor, and the sediment-related habitat metrics have been low, sediment seems like the most plausible cause of stress in the impaired North Fork Pound River segment.

Analysis of Candidate Stressors for South Fork Pound River

The purpose of the stressor analysis is to look for a stressor that was present in the initial listing period of South Fork Pound River. South Fork Pound River was enlisted as impaired in 1994. The VaSCI ratings reported for all the stations located in South Fork Pound river show that the benthic community is under severe stress. The stressor may be something that either directly affected the benthic community or indirectly affected its habitat. Habitat metrics were very poor during the listing period for all of South Fork Pound River biological stations.

A list of candidate stressors was developed for South Fork Pound River and evaluated to determine the pollutant(s) responsible for the benthic impairment. A potential stressor checklist was used to evaluate known relationships or conditions that may show cause and effect between potential stressors and changes in the benthic community. An outline of available evidence was then summarized as the basis for each potential stressor. Candidate stressors included ammonia, hydrologic modifications, nutrients, organic matter, pH, sediment, TDS, conductivity, sulfates, temperature, and toxics. The evaluation of each candidate stressor is discussed in the following sections.

3.1.4. Eliminated Stressors

Ammonia

High values of ammonia are toxic to many fish species and may impact the benthic community as well. The values of ammonia recorded at station PNS003.38 which is just below the confluence with Glady Fork show an apparent elevated level of ammonia in samples collected from 1976-79. However, a closer look at the data revealed a higher minimum analytical detection limit (MDL) of 0.10 mg/L, with most of the samples at or below the MDL. The samples collected in 2006 show ammonia at or below the current MDL of 0.04 mg/L. Hence ammonia was eliminated as a stressor.

Temperature

South Fork Pound River is classified as a Class IV mountain stream with a maximum temperature standard of 31°C. Although riparian vegetation in South Fork Pound River has received poor scores that could affect stream shading, riparian vegetation scores at the intermediate biological station – PNS003.94 – were not low and no exceedences of this standard have ever been recorded either in the DEQ or DMLR monitoring data sets. Therefore, temperature does not appear to be the cause of the benthic impairment and was eliminated as a possible stressor.

3.1.5. Possible Stressors

Hydrologic Modifications

Extensive mining has occurred, and is ongoing, in the watershed. Twenty-eight permitted sediment ponds are scattered throughout the watershed, and re-contoured reclaimed AML land exists in various parts of the watershed. Residential areas are primarily confined to the valley and floodplain corridor, along with the additions of roads and other impervious areas. The Donald Branch and Phillips Creek watersheds which are tributary to the South Fork Pound River have been almost totally mined with the aquatic habitat previously afforded by Donald Branch totally eliminated during the reclamation effort, as Donald Branch no longer exists as a surface feature. These modifications are all possible sources of stress on the biological communities along the South Fork Pound River.

Nutrients

Elevated nutrient inputs can lead to excessive algal growth, eutrophication, and low dissolved oxygen concentrations which may adversely affect the survival of benthic macro-invertebrates. In particular, dissolved oxygen levels may become low during overnight hours due to plant respiration. The average dissolved N concentration in 1976-79 was 0.73 mg/L which was approximately a median value for the state. In 2006, the average concentration has increased to 2.07 mg/L and is near the 92nd-percentile state-wide. The benthic communities at all the stations have been dominated by nutrient loving organisms. The small amount of riparian vegetation near the outlet of the South Fork Pound River may also promote increased nutrient transport through surface runoff. The limiting nutrient for eutrophication in South Fork Pound River is phosphorus, but almost all phosphorus measurements are at or barely above its analytical MDL, and so is already at very low levels and, therefore, none of the measurements have even come close to DEQ's "threatened waters" threshold of 0.2 mg/L TP. N levels were fairly average at the time of initial listing, with increases being more recent and, while they may have possibly been related to the initial cause of stress on the biological community, the low availability of P make that unlikely. Nutrients are, therefore, considered to be a possible stressor.

Organic Matter

Excessive organic matter can lead to low in-stream dissolved oxygen concentrations which may adversely affect the survival and growth of benthic macro-invertebrates. Potential sources of organic matter include household wastewater discharges, mining wastes, and agricultural runoff. High values of the modified family biotic index (MFBI) metric in South Fork Pound River are indicative of organic-enriched streams. Organic enrichment is also supported by the types of dominant benthic organisms found in all of the samples in South Fork Pound River– Hydropsychidae and Chironomidae – typical of organic-enriched sites, and the low ratios of scrapers to filterer-collectors, indicative of abundant suspended organic matter used as a food source for the filterer-collectors. Although there apparently are available sources of organic enrichment, no problems were monitored with DO depletion, and COD levels were minimal. Other organic indicators – low concentrations of TP, low volatile solids, and low TKN/TN fractions – do not support organics as a major source of stress. This situation could possibly be caused by organic contributions from mal-functioning septic systems and straight pipes, as the majority of residences in this watershed are not sewered and living in close proximity to streams. These organic inputs, therefore, could be at low concentrations and widely available as external food inputs to the benthic community. This could lead to a less diverse community that could have adapted to these chronic slightly elevated levels of organic and nutrient inputs. Organic matter is, therefore, considered to be a possible stressor.

pH

Benthic macro-invertebrates require a specific pH range of 6.0 to 9.0 to live and grow. Changes in pH may adversely affect the survival of benthic macro-invertebrates. Treated wastewater, acid mine drainage, acid rain, and urban runoff can potentially alter in-stream levels of pH. While no exceedences of the minimum or maximum pH standard were recorded at any of the DEQ stations or DMLR in-stream monitoring, DMLR groundwater monitoring revealed the potential for low pH values. pH was therefore considered to be a possible stressor, even though no in-stream violations have been recorded.

Toxics

The presence of toxics as a stressor in a watershed may be supported by very low numbers of any type of organisms, exceedences of freshwater aquatic life criteria or consensus-based Probable Effect Concentrations (PEC) for metals or inorganic compounds, by low percentages of the shredder population, reports of fish kills, or by the presence of available sources. The total numbers of benthic organisms in samples taken at the outlet of South Fork Pound River were low in several samples in the early 1990s. Nickel has been measured in exceedence of its consensus-based PECs at two stations in the South Fork Pound River, one downstream of South Fork middle sub-watershed in 2001 and another downstream from the Glady Fork subwatershed in 2006. The percentage of shredders at all the stations in the watershed has been low, but there have been no reports of fish kills or exceedences of any known aquatic life or human health criteria. Toxics are considered as a possible stressor although the available evidence does not precede the listing of this watershed in time. Therefore, toxics are considered to be a possible, but not one of the most probable, stressors.

3.1.6. Most Probable Stressors

The two most probable stressors to the benthic community are considered to be sediment and TDS based on the following summary of available evidence.

<u>Sediment</u>

Excessive sedimentation can impair benthic communities through loss of habitat. Excess sediment can fill the pores in gravel and cobble substrate, eliminating macro-invertebrate habitat. Potential sources of sediment include agricultural and residential runoff, forestry and mining operations, runoff from abandoned mine land, construction sites, and in-stream disturbances. Although the %Haptobenthos metric has been low in a number of samples at both the upstream and downstream biological stations on South Fork Pound River, the intermediate station had a very healthy population, although all of these samples were taken at different times in different years. Sediment is supported as a stressor through the poor habitat metrics related to sediment included bank stability, embeddedness, riparian vegetation, and sediment deposition. The only permitted point sources in the watershed are three 1000-gpd single family General Permits, whose contributions are minor, and the DMME mining permits, whose owners are required to install best management practices (BMPs) and to use sediment control measures to minimize erosion to the extent possible. Therefore, sediment problems appear to be related to barren areas in the watershed that are subject to soil detachment and runoff, disturbed areas within existing or previously mined areas, and abandoned mine land (AML). Disturbed permitted mining areas include recently cleared forested areas, land cleared for surface mining, and poorly-vegetated AML. Additionally, new construction, poorly vegetated riparian areas along streams, and in-stream disturbances would also add to the sediment load. This evidence supports the inclusion of sediment as one of the most probable stressors in the South Fork Pound River.

TDS

Total dissolved solids (TDS) are the inorganic salts, organic matter and other dissolved materials in water. Since sulfates are one of the constituent components of the TDS measurement, and conductivity measurements are a correlate of TDS, TDS will be used as the stressor that is evidenced by this suite of parameters. Elevated levels of TDS cause osmotic stress and alter the osmoregulatory functions of organisms (McCulloch et al., 1993). Average TDS, conductivity, and sulfate concentrations were greater than their respective screening values – 500 mg/L, 500 µmhos/cm, and 250 mg/L – at almost every active MPID with DMLR in-stream, sediment pond, and groundwater monitored data. Active DMLR in-stream, sediment pond, and groundwater monitoring sites were available for Rat/Short Creeks, Glady Fork, South Fork Middle, and South Fork Upper sub-watersheds. DEQ ambient monitoring in 2006-07 at station PNS003.38 also showed conductivity and sulfate concentrations above screening values (TDS was not monitored). High levels of TDS have been associated with poor benthic community health and are considered to be a major contributor to the stress being shown by the benthic community at PNS000.40 and PNS004.98 along the South Fork Pound River, and are considered to be one of the most possible stressors.

Analysis of Candidate Stressors for Phillips Creek

The purpose of the stressor analysis is to look for a stressor that was present during the listing period for Phillips Creek. Phillips Creek and the former Donald Branch are headwaters of South Fork Pound River and were initially listed as impaired in 2002. As mentioned previously, Donald Branch no longer exists as a surface feature due to pre-law modifications and will not be included in the TMDL developed for the VAS-Q13R-04 segment. The VaSCI ratings reported for the station just below the confluence of these two streams (PNS008.73) shows that the benthic community is under severe stress. The stressor may be something that either directly affected the benthic community or indirectly affected its habitat.

A list of candidate stressors was developed for Phillips Creek and evaluated to determine the pollutant(s) responsible for the benthic impairment. A potential stressor checklist was used to evaluate known relationships or conditions that may show cause and effect between potential stressors and changes in the benthic community. An outline of available evidence was then summarized as the basis for each potential stressor. Candidate stressors included ammonia, hydrologic modifications, nutrients, organic matter, pH, sediment, TDS, conductivity, and sulfates, temperature, and toxics. The evaluation of each candidate stressor is discussed in the following sections.

3.1.7. Eliminated Stressors

<u>Ammonia</u>

High values of ammonia are toxic to many fish species and may impact the benthic community as well. There is no data for ammonia available at the outlet of Phillips Creeks. However, all of the samples taken farther downstream on the South Fork Pound River were at or below the minimum analytical detection limit, and there is no known source of ammonia in the watershed, so it was eliminated as a potential stressor.

<u>Temperature</u>

Phillips Creek is classified as Class IV mountain streams with a maximum temperature standard of 31°C. No exceedences of the standard were recorded either by DMLR monitoring in Phillips Creek or by DEQ monitoring at PNS008.73 during collection of the biological samples. The riparian vegetation metric measured during the habitat assessment at a site downstream from Phillips Creek (PNS003.78) further showed adequate cover in 1999 and has improved in 2006. Therefore, there is no evidence supporting temperature as a stressor, so it was eliminated.

3.1.8. Possible Stressors

<u>Nutrients</u>

Excessive nutrient inputs can lead to excessive algal growth, eutrophication, and low dissolved oxygen concentrations which may adversely affect the survival of benthic macro-invertebrates. In particular, dissolved oxygen levels may become low during overnight hours due to plant respiration. In Phillips Creek, the benthic community is overwhelming dominated by Chironomidae, although its numbers have decreased and diversity has increased since 1999. Although this organism is often found in streams with elevated nutrients, there are no known sources of non-natural nutrients in this watershed, with the possible exception of fertilization on reclaimed AML areas, which is usually a one-time application at recommended rates. TP levels at downstream stations on the South Fork Pound River are at very low levels, so phosphorus does not appear to be a stressor. Nutrients are left in as a possible stressor because of the possibility of contributions of nitrogen in runoff from fertilized areas.

<u>Organic Matter</u>

Excessive organic matter can lead to low in-stream dissolved oxygen concentrations which may adversely affect the survival and growth of benthic macro-invertebrates. Potential sources of organic matter in these watersheds are expected to be minor and related to mining operation wastes. Moderate to high values of the modified family biotic index (MFBI) metric may be indicative of organic-enriched streams. Organic enrichment is also supported by the types of dominant benthic organisms found in all of the samples in South Fork Pound River- Chironomidae, and Simuliidae – typical of organic-enriched sites, and the high percentage of filter-collectors that rely on suspended organic matter as their food source. No data was available for BOD5 or COD, but dissolved oxygen levels recorded during biological sampling were in compliance with the DO standard. Organic matter is considered to be a possible stressor, though its exact source is unknown.

pH

Benthic macro-invertebrates require a specific pH range of 6.0 to 9.0 to live and grow. Changes in pH may adversely affect the survival of benthic macro-invertebrates. Treated wastewater, acid mine drainage, and acid rain can potentially alter in-stream levels of pH. Although no exceedences of the minimum or maximum pH standard were reported in DMLR in-stream monitoring within Phillips Creek or at station PNS008.73 corresponding with the biological samples, DMLR groundwater pH values frequently exceeded the minimum pH limit and could influence in-stream pH values. Therefore, pH was considered to be a possible stressor.

Toxics

The presence of toxics as a stressor in a watershed may be supported by very low numbers of any type of organisms, exceedences of freshwater aquatic life criteria or consensus-based Probable Effect Concentrations (PEC) for metals or inorganic compounds, by low percentages of the shredder population, reports of fish kills, or by the presence of available sources. The shredder population was reported to be very low, but there have been no reports of fish kills. The benthic organism sample counts taken at the outlet of Donald Branch and Phillips Creek are also typical of streams without a toxics problem. Toxics are considered as a possible stressor because of the dominating presence of the mining industry in the watershed.

3.1.9. Most Probable Stressors

The three most probable stressors to the benthic community are considered to be hydrologic modifications, sediment, and TDS based on the following summary of available evidence.

Hydrologic Modifications

The complete alteration and rearrangement of the hydrology in the Phillips Creek and Donald Branch watersheds is the most probable stressor on the biological community. Donald Branch has been modified to such an extent, that it no longer exists as a surface feature and all drainage from the former watershed is entirely subsurface, resulting in the elimination of all stream habitat in this watershed. The removal of all upstream habitat in the Donald Branch watershed has undoubtedly affected the population available for populating downstream habitat as assessed at PNS008.73. However, since "hydrologic modification" is not classified as a "pollutant" by USEPA in the Clean Water regulations, a TMDL will not be developed for this stressor.

Sediment

Excessive sedimentation can impair benthic communities through loss of habitat. Excess sediment can fill the pores in gravel and cobble substrate, eliminating macro-invertebrate habitat. Potential sources of sediment include agricultural and residential runoff, forestry and mining operations, runoff from abandoned mine land, construction sites, and in-stream disturbances. Riparian vegetation and sediment deposition metric scores were good for all habitat assessments, and much AML land has been reclaimed. However, there is, and has been, mining activity in the majority of the watershed for the past 30-some years that has entailed much land disturbance. The %Haptobenthos (organisms that require clean, coarse substrate) was low at the outlet of Phillips Creek in 1999, but increased from 1999 to 2006, along with the habitat bank stability metric. Excess sedimentation in the watershed appears to be related to disturbed or barren areas in the watershed that are subject to soil detachment and runoff. These include recently cleared forested areas, land cleared for surface mining, poorly-vegetated abandoned mine land (AML), and poorly vegetated riparian areas along streams. Because of the nature of the dominant activity in the watershed – mining – sediment must be considered a most possible stressor, even though direct supportive measured evidence is not available.

TDS

The average TDS and conductivity measurements reported in DMLR in-stream and groundwater monitoring data for Phillips Creek watershed were greater than the screening values of 500 mg/L and 500 µmhos/cm, respectively. Sulfate values were greater than the screening value of 250 mg/L for Phillips Creek for in-stream monitoring. High levels of TDS have been associated with poor benthic community health in other mining watersheds and are considered to be a major contributor to the stress being shown by the benthic community at PNS008.73.

Summary

The benthic impairment on the Lower North Fork Pound River stream segment (VAS-Q13R-02) is relatively minor, with individual VaSCI sample scores varying between 35.0 and 65.9 and an average score of 55.4 for samples in 2006. This segment is located downstream from the North Fork Pound Lake, which does not appear to be a source of pollutants and serves as a sink for upstream pollutants. The impaired segment only has ambient data for 2006-07 and has a 6-yr gap in the biological data. Stacy Branch is a major tributary to the impaired segment. Recent monitoring has shown that contributions from Stacy Branch appear to be no different than the watershed as a whole. The impaired segment is poorly buffered with alkalinity measurements below 20 mg/L, but does not appear to have any immediate threats from sources of acidity. Sediment was selected as the most probable stressor based on the repeated poor scores for sediment metrics in the habitat assessments.

The benthic impairment on the South Fork Pound River stream segment (VAS-Q13R-01) has shown consistently low values of the VaSCI with a 2006 average of 33.1. Extensive mining has also impacted this watershed. While this watershed has more ambient data than the others, it also has a 26-yr gap in ambient data between 1980 and 2006, and only occasional biological samples between 2000 and 2006. There are 3 biological monitoring sites along this segment. Although samples from these stations vary in time, the middle station is characterized by slightly better habitat and benthic community metrics than at the upstream and downstream sites. Although TP measurements are at barely detectable levels, nitrogen levels have increased over time. The source of nitrogen is unknown, but does not appear to be the major stressor. High monitored TSS concentrations from DMLR monitoring and poor habitat metrics led to the selection of sediment as a most probable stressor. Additionally, widespread elevated levels of TDS and its related parameters – conductivity and sulfates – led to its inclusion as a most probable stressor as well. Since TDS is a correlate of conductivity and includes sulfate concentrations in its measurement, TDS was selected as most representative of this suite of parameters and the parameter around which to calculate a TMDL.

The benthic impairment on Phillips Creek (VAS-Q13R-04) is quite severe with a 3-sample VaSCI average score of 15.1. The hydrology in the Phillips Creek and Donald Branch watersheds has been radically altered through extensive mining and reclamation. Almost the entire Phillips Creek watershed is included in various mining permits. Extensive mining in these headwaters has resulted in the elimination of all lotic aquatic habitat in this watershed which also affects downstream propagation of these organisms. No ambient data is available for these watersheds, and a 7-yr gap exists between the first and the last two biological samples. All measurements of TDS and its related parameters have been extremely high, and, TDS was selected as most representative of this suite of parameters. Hydrologic modifications, sediment, and TDS, therefore, have been selected as the most probable stressors on this impaired segment.

CHAPTER 4: THE REFERENCE WATERSHED MODELING APPROACH

Introduction

Virginia has no numeric in-stream criteria for either of the most probable stressors identified in this study, sediment and TDS. As a result, a “reference watershed” approach was used to set allowable loads for these constituents in the impaired watershed.

The reference watershed approach pairs two watersheds – one whose streams are supportive of their designated uses and one whose streams are impaired. This reference watershed may be, but does not have to be, the watershed corresponding to the reference monitoring site used for determining comparative biological metric scores. The reference watershed is selected on the basis of similarity of land use, topographical, ecological, and soils characteristics with those of the impaired watershed. This approach is based on the assumption that reduction of the stressor loads in the impaired watershed to the level of the loads in the reference watershed will result in elimination of the benthic impairment.

The reference watershed approach involves assessment of the impaired reach and its watershed, identification of potential causes of impairment through a benthic stressor analysis, selection of an appropriate reference watershed, model parameterization and pollutant simulation within the TMDL watershed, definition of the TMDL endpoint, and development of alternative TMDL reduction (allocation) scenarios. TMDL endpoints may be developed using either modeled loads or a statistical measure of monitored pollutant concentrations from the reference watershed. Where a simulated load is used as the TMDL endpoint, pollutant loads are also simulated from the reference watershed.

Selection of Reference Watersheds for Sediment

4.1.1. Comparison of Potential Watersheds

Reference watersheds were selected for each of the watersheds containing an impaired segment. The list of potential reference watersheds was comprised of four watersheds that corresponded with biological monitoring reference sites used at one time or another for evaluating RBP II metrics for one of the DEQ biological stations in the watershed. Two biological stations are listed for Dismal Creek and are referred to as Upper Dismal Creek (6ADIS017.94) and Lower Dismal Creek (6ADIS003.52). The lower station was included since TDS monitoring data was not available at the upper site, but was available just downstream of the lower station. Minimal differences exist among the eco-region classifications for all of the potential reference watersheds. Table 4.1 compares the various characteristics of the candidate reference watersheds to the characteristics of the impaired watershed. Representative characteristics that were compared include land use distribution, relative percentage of present and historic extractive land uses, average soil erodibility, average percent slope, average elevation, number of non-sewered homes, population density, and VaSCI scores. The Universal Soil Loss Equation (USLE) K-factor was used as an index of the erosivity of soils in the watersheds, and was calculated as a weighted average of all soil K-factors in each watershed.

Table 4.1. Reference Watershed Comparisons for North Fork and South Fork Pound River Impaired Segments

			Landuse Distribution				Historic	DMLR	Watershed Average			Latest SCI			
Station ID	Stream Name	Area (ha)	Urban (%)	Forest (%)	Agr (%)	Extr (%)	AML area (%)	Permit Area (%)	STATSGO K-factor	Slope (%)	Elevation (meters)	Score	Date	SubEco Region	County
							Impaired Watershed								
6APNK000.08	Lower N.F. Pound River	466	10%	86%	4%	0%	0.00%	0.00%	0.204	31	608	57.90	Nov-06	69d	Wise
							Potential TMDL Reference Watersheds								
6ADIS017.94	Upper Dismal Creek	7,228	3%	94%	2%	1%	5.09%	1.63%	0.206	41	748	68.62	Nov-97	69d	Buchanan
6BBAI000.26	Baileys Trace	1,085	3%	81%	3%	13%	8.14%	16.96%	0.207	45	688	53.40	Sep-99	69d	Lee
6BBUC000.24	Burns Creek	736	1%	84%	1%	15%	0.00%	0.00%	0.201	25	880	70.11	May-06	69d	Wise
							Impaired Watershed								
6APNS000.40	Complete S.F. Pound River	4,729	4%	50%	7%	38%	12.45%	31.16%	0.202	36	645	46.40	Nov-06	69d	Wise
							Potential TMDL Reference Watersheds								
6ADIS017.94	Upper Dismal Creek	7,228	3%	94%	2%	1%	5.09%	1.63%	0.206	41	748	68.62	Nov-97	69d	Buchanan
6ADIS003.52	Lower Dismal Creek	22,069	0%	97%	1%	2%	0.04%	1.78%	0.240	24	675	66.30	Nov-06	69d	Buchanan
6BMTN003.56	Martin Creek	4,731	2%	52%	46%	1%	0.00%	0.00%	0.288	22	493	61.58	Jun-98	67f	Lee
6BBAI000.26	Baileys Trace	1,085	3%	81%	3%	13%	8.14%	16.96%	0.207	45	688	53.40	Sep-99	69d	Lee
							Impaired Watershed								
6APNS008.73	Phillips Creek	504	0%	67%	0%	32%	7.23%	94.67%	0.203	57	836	18.50	Nov-06	69d	Wise
							Potential TMDL Reference Watersheds								
6ADIS017.94	Upper Dismal Creek	7,228	3%	94%	2%	1%	5.09%	1.63%	0.206	41	748	68.62	Nov-97	69d	Buchanan
6BBAI000.26	Baileys Trace	1,085	3%	81%	3%	13%	8.14%	16.96%	0.207	45	688	53.40	Sep-99	69d	Lee
6BBUC000.24	Burns Creek	736	1%	84%	1%	15%	0.00%	0.00%	0.201	25	880	70.11	May-06	69d	Wise

- Impaired watershed
- Closest matches
- Selected Reference Watershed

EcoRegion	67	Central Appalachian Ridges and Valleys
	69	Central Appalachians
SubEcoRegion	67f	Southern Limestone/Dolomite Valleys and Low Rolling Hills
	69d	Cumberland Mountains

4.1.2. The Selected Reference Watersheds for Sediment

The watershed characteristics in Table 4.1 were evaluated and considered during this comparison between watersheds corresponding to each of the impaired segments and potential reference watersheds. The reference watershed selected for the Lower North Fork Pound River was Burns Creek. Burns Creek was similar in size, was primarily forested similar to the Lower North Fork, and has no historic AML or active mining permits, also comparable to the Lower North Fork. Mining influences in the Upper Dismal Creek and Baileys Trace were considerably different from the Lower North Fork, and Martin Creek was considerably more agricultural and was the only potential reference in a slightly different sub-eco-region.

The two impaired segments on the South Fork Pound River were in nested sub-watersheds, so it was important to choose the same reference watershed for both segments in order to preserve the relative reductions required from each. While Baileys Trace appeared to match many of the South Fork Pound River characteristics better, Upper Dismal Creek was selected as a better match for the reference watershed for the following reasons. Although Baileys Trace had been used previously as a reference site for the RBP II comparisons, the only available biological sample from this site showed impairment based on the VaSCI, and therefore this site was not considered to be an appropriate reference. The high percentage of agricultural land in Martin Creek was its major disadvantage, and the lack of mining influences in Burns Creek made it inappropriate as a reference for the South Fork Pound River watersheds.

<u>TMDL Modeling Endpoints</u>

4.1.3. Sediment

For each of the impaired segments, the size of the selected reference watershed was adjusted to match the area of the impaired watershed. Land use distributions and other watershed characteristics were preserved throughout the adjustments.

For the Lower North Fork Pound River impairment (VAS-Q13R-02), the reference watershed approach was applied by area-adjusting the non-impaired Burns Creek (6BBUC000.24) watershed to the area of the Lower North Fork watershed and the simulated sediment load (t/yr) from the area-adjusted Burns Creek watershed was used as the TMDL target endpoint.

For the impairments in the South Fork Pound River (VAS-Q13-01) and the Phillips Creek (VAS-Q13R-04), this approach was applied using the same reference watershed since these are nested watersheds. Using the same reference watershed maintains the required reductions between the two nested segments in an appropriate relative relationship. The sediment load TMDL target endpoint (t/yr) for the South Fork impaired segments was set as the sediment load from the non-impaired reference watershed, Upper Dismal Creek (above station 6ADIS017.94), area-adjusted respectively to the South Fork Pound River and the Phillips Creek watersheds.

4.1.4. TDS

Concentration was determined to be the appropriate type of endpoint in determining the TDS TMDL for the South Fork Pound River impaired stream segments. Although the Upper Dismal Creek watershed, which was used as a reference watershed for these segments for sediment, had no ambient DEQ monitoring stations with which to assess an appropriate TDS endpoint, DEQ did have a downstream monitoring site with TDS data available at station 6ADIS001.24, referred to as Lower Dismal Creek. While the Lower Dismal Creek watershed is larger than the Upper Dismal Creek watershed, it is very similar in its physical characteristics, has some mining activity, and has had several bioassessment samples taken which show a healthy aquatic community at stations 6ADIS003.52 and 6ADIS013.73. TDS data from station 6ADIS0001.24 in Lower Dismal Creek has also been used previously to set the TDS TMDL endpoint for the Knox Creek TMDL (MapTech, 2006). The TDS TMDL concentration endpoint for both South Fork Pound River impaired segments was set at 369 mg/L, the 90th percentile of 34 DEQ-monitored TDS samples taken at station 6ADIS001.24.

Reductions in sediment to the TMDL target load and reductions in TDS loads to the TMDL target concentration are expected to allow benthic conditions to return to a non-impaired state.

CHAPTER 5: MODELING PROCESS FOR DEVELOPMENT OF THE SEDIMENT TMDL

A key component in developing a TMDL is establishing the relationship between pollutant loads (both point and nonpoint) and in-stream water quality conditions. Once this relationship is developed, management options for reducing pollutant loads to streams can be assessed. In developing a TMDL, it is critical to understand the processes that affect the fate and transport of the pollutants and cause the impairment of the water body of concern. Pollutant transport to water bodies is evaluated using a variety of tools, including monitoring, geographic information systems (GIS), and computer simulation models. In the development of the sediment TMDLs for the North Fork and South

Fork Pound River watersheds, the relationships were defined through computer modeling. In this chapter, the modeling process, input data requirements, and model calibration procedures for sediment are discussed.

Model Selection

The reference watershed approach was used in this study to develop sediment TMDLs to partially address the benthic impairment in the North Fork and South Fork Pound River watersheds. The model selected for development of the sediment TMDLs was the Generalized Watershed Loading Functions (GWLF) model, originally developed by Haith et al. (1992), with modifications by Evans et al. (2001), Yagow et al. (2002), and Yagow and Hession (2007).

The loading functions upon which the GWLF model is based are compromises between the empiricism of export coefficients and the complexity of process-based simulation models. GWLF is a continuous simulation spatially-lumped parameter model that operates on a daily time step. The model estimates runoff, sediment, and dissolved and attached nitrogen and phosphorus loads delivered to streams from complex watersheds with a combination of point and non-point sources of pollution. The model considers flow inputs from both surface runoff and groundwater. The hydrology in the model is simulated with a daily water balance procedure that considers different types of storages within the system. Runoff is generated based on the Soil Conservation Service's Curve Number method as presented in Technical Release 55 (SCS, 1986).

GWLF uses three input files for weather, transport, and nutrient data. The weather file contains daily temperature and precipitation for the period of simulation. The transport file contains input data primarily related to hydrology and sediment transport, while the nutrient file contains primarily nutrient values for the various land uses, point sources, and septic system types. The Penn State Visual Basic™ version of GWLF with modifications for use with ArcView was the starting point for additional modifications (Evans et al., 2001). The following modifications related to sediment were made to the Penn State version of the GWLF model, as incorporated in their ArcView interface for the model, AvGWLF v. 3.2:

- Urban sediment buildup was added as a variable input.
- Urban sediment washoff from impervious areas was added to total sediment load.
- Formulas for calculating monthly sediment yield by land use were corrected.
- Mean channel depth was added as a variable to the streambank erosion calculation.

The current Virginia Tech (VT) modified version of GWLF (Yagow and Hession, 2007) was used in this study. The VT version includes a correction to the flow accumulation calculation in the channel erosion routine that was implemented in December 2005 (DEQ, 2005). This version also includes modifications from Schneiderman et al. (2002) to remove the limitation that prevented carry-over of excess detached sediment from one simulated year (that runs from April through March of the following year) to the next, and to add in missing bounds for the calculation of erosivity using Richardson equations which were intended to have minimum and maximum bounds on daily calculations. These minimum and maximum bounds were not included in GWLF 2.0, and have been added to keep calculations within physically expected bounds.

Erosion is generated using a modification of the Universal Soil Loss Equation. Sediment supply uses a delivery ratio together with the erosion estimates, and sediment transport takes into consideration the transport capacity of the runoff. Stream bank and channel erosion was calculated using an algorithm by Evans et al. (2003) as incorporated in the AVGWLF version (Evans et al., 2001) of the GWLF model and corrected for a flow accumulation coding error (DEQ, 2005).

GWLF Model Development

As described in the previous chapter, the Burns Creek watershed was chosen as the reference watershed for the Lower North Fork Pound River. The Burns Creek watershed was area-adjusted to the Lower North Fork Pound River watershed, and the simulated average annual sediment load was used to define the sediment TMDL for the Lower North Fork watershed. Upper Dismal Creek in Buchanan County was selected as the reference watershed for the sediment TMDLs in the nested South Fork Pound River watersheds. The Upper Dismal

Creek was individually area-adjusted to watersheds corresponding to each South Fork Pound River impaired segment, and the respective simulated average annual sediment loads were used to define the sediment TMDLs for each South Fork Pound River impaired stream segment. Model development for the North Fork and South Fork Pound River watersheds and their reference watersheds were performed by assessing the sources of sediment in each watershed, evaluating the necessary parameters for modeling loads, calibrating to observed flow and sediment data, applying the model, and then using post-model processing procedures for calculating loads.

Four sub-watersheds were delineated within the North Fork Pound River watershed and nineteen sub-watersheds were delineated in the South Fork Pound River watershed in order to represent the spatial distribution of land uses and pollutant sources in the watersheds for modeling purposes. Figure 5.1 shows the sub-watershed delineation within the major drainage areas in the North Fork and South Fork Pound River.

Since the North Fork Pound Lake and dam effectively trap most sediment generated from the Upper North Fork Pound River, this portion of the watershed was modeled as a point source discharge into the lower North Fork Pound River watershed. Loads from this watershed were calculated, outside of the GWLF model, as daily sediment loads from an available time-series of flow and sediment concentrations, and added to the GWLF output. Flow data was obtained in the form of U.S. Corps of Engineers (USCOE) daily flow records from the dam outfall. Average daily flow at the dam ranged from 0.81 to 338.39 cfs, and flows above 7 cfs were considered stormflow. DEQ ambient monitoring at station PNK000.08 was used to estimate baseflow and stormflow concentrations of 3 mg/L and 22 mg/L, respectively. The sub-watershed labeled Upper North Fork Pound River, therefore, was not included explicitly in the GWLF model.

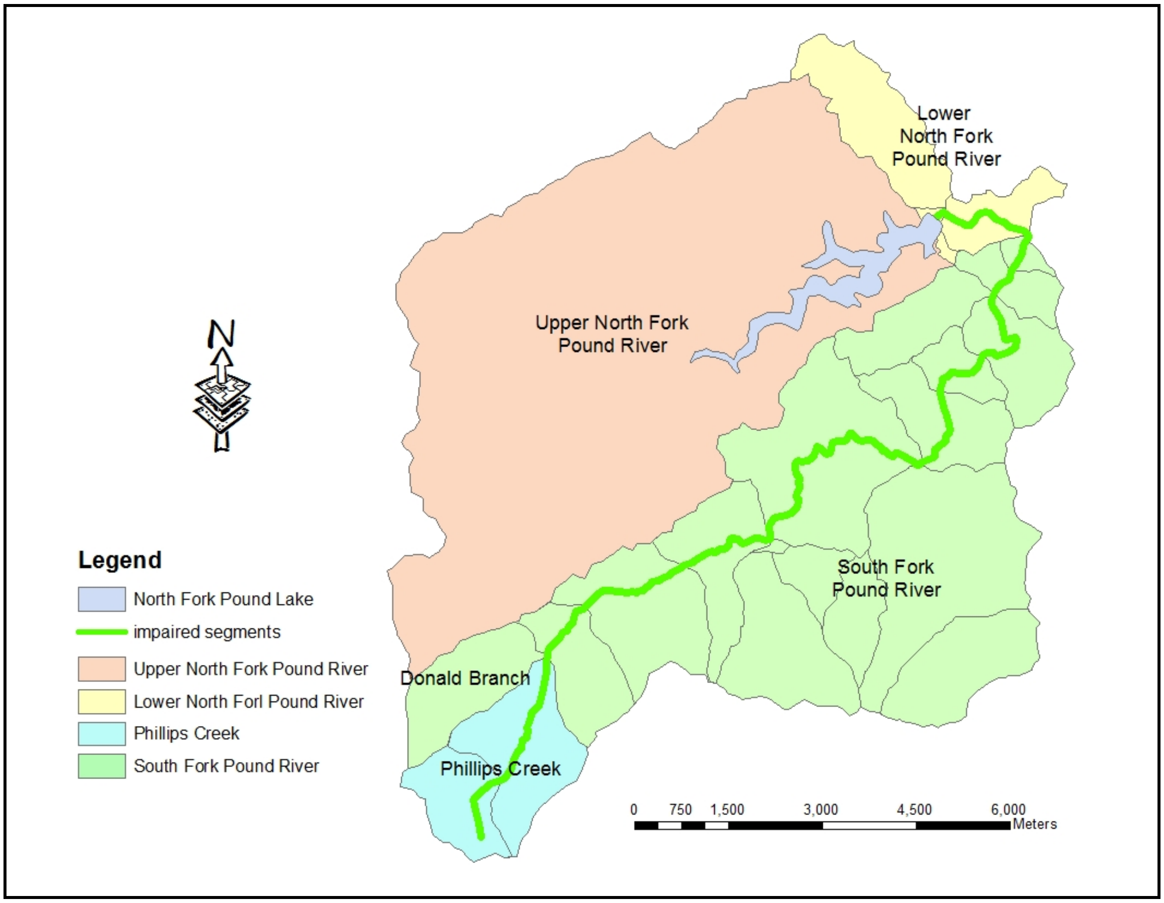

Figure 5.1. GWLF Modeling Sub-watersheds in the North Fork and South Fork Pound River watersheds

Sediment is generated in the North Fork and South Fork Pound River watersheds through the processes of surface runoff, in-channel disturbances, and streambank and channel erosion, as well as from background geologic forces. Sediment generation is accelerated through human-induced land-disturbing activities related to a variety of agricultural, forestry, mining, transportation, and residential land uses.

During runoff events, sediment loading occurs from both pervious and impervious surfaces around the watershed. For pervious areas, soil is detached by rainfall impact or shear stresses created by overland flow and transported by overland flow to nearby streams. This process is influenced by vegetative cover, soil erodibility, slope, slope length, rainfall intensity and duration, and land management practices. During periods without rainfall, dirt, dust and fine sediment build up on impervious areas through dry deposition, which is then subject to washoff during rainfall events. Sediment generated from impervious areas can be reduced through the use of management practices that reduce the surface load subject to washoff.

Vegetative cover and stream buffers in the riparian zone are essential to maintaining stable stream banks. The topography of the North Fork and South Fork Pound River watersheds is such that roads, residences, and businesses are all located in the riparian zones of the narrow valleys throughout this watershed, leaving minimal buffers, if any, and spotty vegetative cover. Additionally, impervious areas, especially in the riparian zone, increase the percentage of rainfall that runs off the land surface leading to larger volumes of runoff with higher peak flows and greater channel erosion potential.

Permitted stormwater discharges in the North Fork and South Fork Pound River watersheds include both short-term and long-term activities. Short-term permitted activities include stormwater erosion and sediment control (E&S) sediment permit limits for construction of gas and oil wells and facilities under the administration of the Virginia Department of Mines, Minerals and Energy; Division of Gas and Oil (DMME-DGO). Long-term permitted activities contributing sediment include industrial stormwater dischargers and runoff from permitted mining activities. All permitted stormwater dischargers have requirements for installation of best management practices to minimize the impact of their activities on water quality. Permitted mining activities are required to have sediment detention pond BMPs installed to detain stormwater runoff from all disturbed land uses. Fine sediment is also included in total suspended solids (TSS) loads that are contributed from the four domestic permits included under the 1,000-gpd general permit within the watershed.

<u>Input Data Requirements</u>

5.1.1. Climate Data

The climate in North Fork and South Fork Pound River watersheds was represented by observations of daily temperature and precipitation from the National Weather Service Cooperative Station 446173 at North Fork Pound Lake, Virginia, while Upper Dismal Creek used data from the Richlands station 447174 in nearby Tazewell County, Virginia, and Burns Creek used data from station 449215 at Wise, Virginia. The North Fork Pound Lake station is located within the watershed approximately 1.1 miles (1.8 km) upstream from the watershed outlet. The period of record used for modeling was a thirteen-year period from January 1995 through December 2007, with the preceding 9 months of data used to initialize model storage parameters. The beginning of this period was chosen to correspond with the beginning of DMLR monitoring data being stored in an electronic format. The locations of the North Fork and South Fork Pound River watersheds and the North Fork Pound Lake station are shown in Figure 5.2.

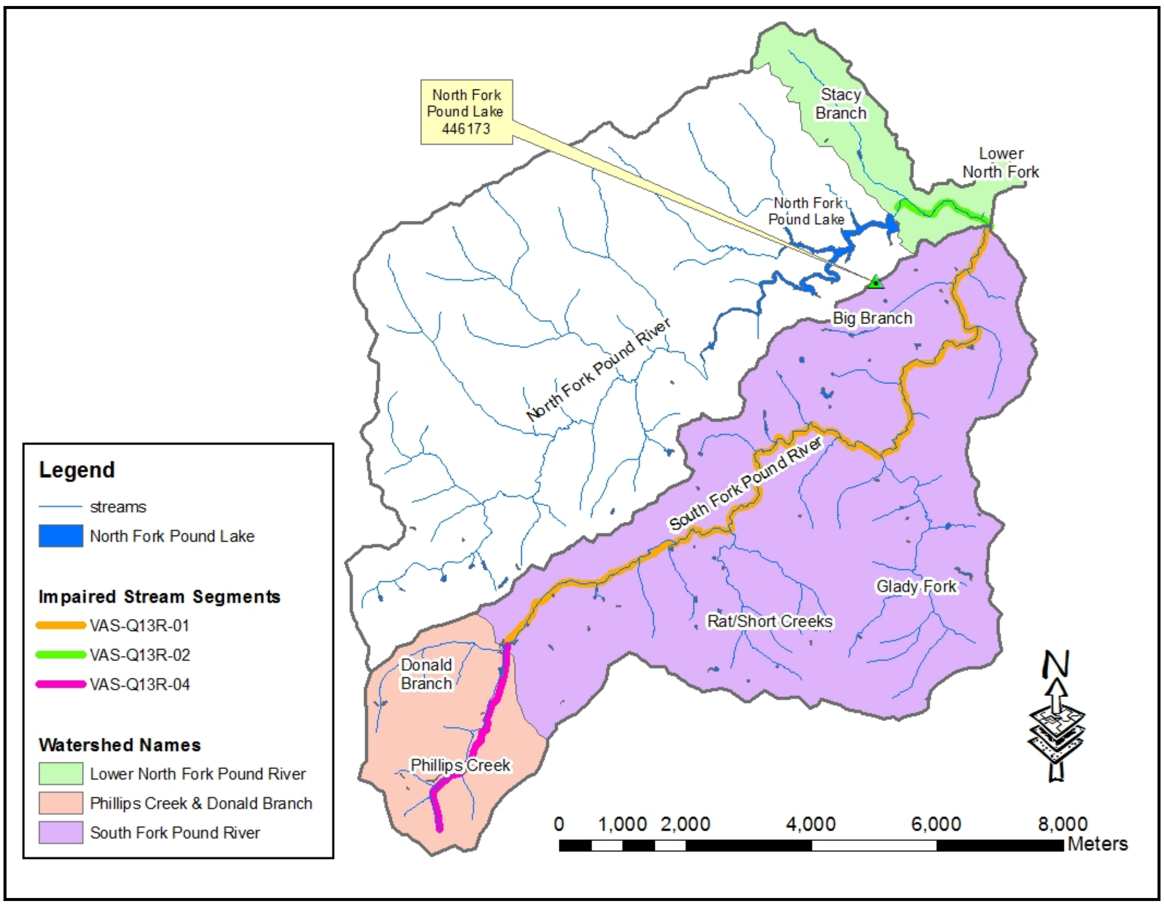

Figure 5.2. Location of North Fork and South Fork Pound River and the North Fork Pound Lake Weather Station

5.1.2. Land Use

Land use for the North Fork and South Fork Pound River watersheds was derived from the Mid-Atlantic RESAC land use-land cover digital data, as discussed in Section 2.5, and shown in Table 5.1. Some additional editing was done to reclassify portions of the “barren” and “extractive” classifications which were inconsistent with mining permit extents and other features observed in VBMP aerial imagery. Barren land uses result from construction of access roads and drilling sites for gas and oil wells, logging, and from residential activities; whereas extractive land uses refer to actively disturbed surface mining areas. The 38 land uses in the RESAC data were re-categorized and three mined land use categories added for spatial analysis: AML, AML within a permit (to be reclaimed), and other permitted mining areas (new mining). Permitted mining areas were further divided into 4 land use categories: “disturbed”, “reclaimed”, “released”, and “to be disturbed”.

Table 5.1. Consolidation of RESAC Land Use Categories for North Fork and South Fork Pound River

TMDL Land Use Categories	Pervious/Impervious (percentage)	RESAC or Mined Land Use Categories
Cropland	Pervious (100%)	Cropland(26)
Pasture	Pervious (100%)	Pasture/hay (25),
Hay	Pervious (100%)	
Urban grass	Pervious (100%)	Urban/Residential/Recreational Grass (15), Natural grass (30)
Forest	Pervious (100%)	Open water (1), Deciduous forest (20), Evergreen forest (21), Mixed forest (22), Deciduous woody wetland (35), Emergent herbaceous (37), also includes portions of mining permits listed as “to be disturbed”
Extractive	Pervious (100%)	Extractive (17), includes fractional portions of existing mining permits listed as “disturbed”
Barren	Pervious (100%)	Barren (18)
Abandoned mine land (AML)	Pervious (100%)	Digitized from USGS 7½-min topographic maps, excluding existing permit areas
Reclaimed	Pervious (100%)	Fractional portions of existing mining permits listed as “reclaimed”
Released	Pervious (100%)	Fractional portions of existing mining permits listed as “released” from bond
Low Density Residential (LDR)	Pervious (88%) Impervious (12%)	Low intensity developed (3), Urban deciduous (10), Urban evergreen (11), Urban mixed (12)
Medium Density	Pervious (70%)	Medium intensity developed (4)

Residential (MDR)	Impervious (30%)	
High Density Residential	Pervious (35%) Impervious (65%)	High intensity developed (5)
Transportation	Pervious (21%) Impervious (79%)	Transportation (8)

Some RESAC land use categories were consolidated based on the similarities in associated sediment sources. Other categories were sub-divided based on available data. The pasture/hay category was subdivided into "Pasture" and "Hay" categories based on percentages assessed during the 2002 Statewide NPS Pollution Assessment study (Yagow et al., 2002). The pervious and impervious portions of the residential categories were modeled separately and cropland was broken down into hi-till and lo-till fractions based on county statistics from the statewide modeling (Yagow et al., 2002).

Based on this categorization, the main land uses in the Lower North Fork watershed are forest, residential, and agricultural, comprising approximately 87%, 9%, and 4%, respectively, of the total watershed area. Land use within the Lower North Fork was assumed to remain fairly stable in the near future. The main land uses in the Phillips Creek watershed are forest and mining, comprising approximately 68% and 32%, respectively, of the total watershed area. The main land uses in the South Fork Pound River watershed are forest, mining, agricultural, and residential, comprising approximately 64%, 24%, 10%, and 2%, respectively, of the total watershed area. The resulting 17 land use categories and their distribution within the North Fork and South Fork Pound River watersheds, and their reference watersheds (Burns Creek and Upper Dismal Creek) are shown in Table 5.2.

Table 5.2. Existing Land Use Areas in the North Fork and South Fork Pound River and their Reference Watersheds

Modeled Land Use Categories	Lower North Fork Pound River (ha)	Area-Adjusted Burns Creek (ha)	Phillips Creek (ha)	Area-Adjusted Upper Dismal Creek (ha)	South Fork** (ha)	Area-Adjusted Upper Dismal Creek (ha)
Cropland	0.0	0.6	0.1	0.1	19.5	0.5
Pasture	16.2	3.6	0.9	7.9	372.1	71.4
Hay	3.2	1.0	0.2	0.0	73.5	0.0
Forest	403.4	390.3	342.5	452.0	2,899.1	4,077.4
Barren	8.0	67.7	10.2	4.0	51.6	36.2
Mining						
Extractive	0.0	0.0	137.0	0.6	648.3	5.7
Reclaimed	0.3	0.0	9.9	0.4	152.5	3.9
Released	0.0	0.0	1.2	0.5	220.3	4.2
AML	0.0	0.0	1.8	24.0	36.5	216.7
LDR - pervious	6.3	2.3	0.0	8.6	42.5	77.8
MDR - pervious	3.0	0.0	0.0	0.0	3.4	0.2
HDR - pervious	3.7	0.2	0.0	0.4	4.4	3.3
Trans - pervious	2.8	0.0	0.0	0.7	1.3	6.6
LDR - impervious	0.9	0.3	0.0	1.2	5.8	10.6
MDR - impervious	1.3	0.0	0.0	0.0	1.4	0.1
HDR - impervious	6.8	0.3	0.0	0.7	8.2	6.0
Trans - impervious	10.5	0.0	0.0	2.7	5.0	24.6
Total Area	**466.4**	**466.4**	**503.8**	**503.8**	**4,545.3**	**4,545.3**
% Forest	86.5%	83.7%	68.0%	89.7%	63.8%	89.7%
% Agriculture	4.2%	1.1%	0.2%	1.6%	10.2%	1.6%
% Urban/residential	9.3%	15.2%	0.0%	2.8%	1.6%	2.8%
% Mining	0.1%	0.0%	31.8%	5.9%	24.4%	5.9%

** The South Fork Pound River watershed also includes Phillips Creek.

Except for re-distribution of disturbed, reclaimed and released areas within active mining permits, land use within the South Fork Pound River was assumed to remain fairly stable in the near future. TMDL allocation scenarios were modeled based on existing land use conditions with additional WLA allocations for new mining permits and transitional construction permits for gas & oil well installation to accommodate future growth.

Each land use within a sub-watershed formed a hydrologic response unit (HRU). Model parameters were calculated for each HRU using GIS analysis to reflect the variability in topographic and soil characteristics across the watershed. A description of model parameters follows in the next section.

<u>GWLF Parameter Evaluation</u>

All parameters were evaluated in a consistent manner between each pair of impaired and reference watersheds, in order to ensure their comparability for the reference watershed approach. All GWLF parameter values were evaluated from a combination of GWLF user manual guidance (Haith et al., 1992), AVGWLF procedures (Evans et al., 2001), procedures developed during the 2002 statewide NPS pollution assessment (Yagow et al., 2002), and best professional judgment. Initial parameter values for active mining and AML land uses were evaluated from available literature sources, as shown in Table 5.3.

Table 5.3. Initially Assigned Curve Numbers and C-Factors Prior to Calibration

Mining Land Use	Curve Number (CN)[1]	C-factor (vegetative cover)	C-factor Definition and Source
Extractive	88	0.664	MPWS[2]: 60% bare soil (0.45); 30% active mining (1.00); 10% regrading (0.94); Barfield et al., p.339
AML	88	0.288	MPWS[2]: 30% residue cover, poor soil, 50% weed cover; Barfield et al., p.391
Reclaimed	83.4	0.071	Pasture: no appreciable canopy, 60% cover (40% grass-60% weed); Wischmeier and Smith, p.32
Released	75.4	0.028	Pasture: no appreciable canopy, 80% cover (half grass-half weed); Wischmeier and Smith, p.32

[1] CN source: Technical Release 55 (TR-55), USDA-SCS, 1986; reclaimed and released values are weighted averages by hydrologic soil type.
[2] MPWS - mechanically prepared woodland sites.

Soil erodibility (K-factors) and %slope for barren, extractive, and AML were evaluated using GIS. K-factors for reclaimed and released land uses were calculated as 1.2 and 1.1 times the extractive land use values, respectively, to simulate the higher bulk density, lower porosity, and lower hydraulic conductivity in post-mined soils (Galbraith, 2004; Ritter and Gardner, 1991), which are expected to decrease over time in the released areas. Percent slope for reclaimed and released land uses were calculated as 0.9 times the extractive land use values. Select initial parameter values were then calibrated as discussed in section 5.8.

Hydrologic and sediment parameters are all included in GWLF's transport input file, with the exception of urban sediment buildup rates, which are in the nutrient input file. Descriptions of each of the hydrologic and sediment parameters are listed below according to whether the parameters were related to the overall watershed, to the month of the year, or to individual land uses.

5.1.3. Hydrology Parameters

Watershed-Related Parameter Descriptions

- Unsaturated Soil Moisture Capacity (SMC, cm): The amount of moisture in the root zone, evaluated as a function of the area-weighted soil type attribute - available water capacity.
- Recession coefficient (day^{-1}): The recession coefficient is a measure of the rate at which streamflow recedes following the cessation of a storm, and is approximated by averaging the ratios of streamflow on any given day to that on the following day during a wide range of weather conditions, all during the recession limb of each storm's hydrograph. This parameter was evaluated using the following relationship from Lee et al. (2000): RecCoeff = 0.045+1.13/(0.306+Area in square kilometers)
- Seepage coefficient (day^{-1}): The seepage coefficient represents the amount of flow lost as seepage to deep storage and was initially set to zero for all watersheds in this study.

The following parameters were initialized by running the model for a 9-month period prior to the period used for load calculation:

- Initial unsaturated storage (cm): Initial depth of water stored in the unsaturated (surface) zone.
- Initial saturated storage (cm): Initial depth of water stored in the saturated zone.
- Initial snow (cm): Initial amount of snow on the ground at the beginning of the simulation.
- Antecedent Rainfall for each of 5 previous days (cm): The amount of rainfall on each of the five days preceding the first day in the weather file

Month-Related Parameter Descriptions

- Month: Months were ordered, starting with April and ending with March – in keeping with the design of the GWLF model.
- ET_CV: Composite evapotranspiration cover coefficient, calculated as an area-weighted average from land uses within each watershed.

- Hours per Day: Mean number of daylight hours.
- Erosion Coefficient: This is a regional coefficient used in Richardson's equation for calculating daily rainfall erosivity. Each region is assigned separate coefficients for the months October-March, and for April-September.

Land Use-Related Parameter Descriptions

- Curve Number: The SCS curve number (CN) is used in calculating runoff associated with a daily rainfall event, evaluated using SCS TR-55 guidance.

5.1.4. Sediment Parameters

Watershed-Related Parameter Descriptions

- Sediment delivery ratio: The fraction of erosion – detached sediment – that is transported or delivered to the edge of the stream, calculated as an inverse function of watershed size (Evans et al., 2001).

Land Use-Related Parameter Descriptions

- USLE K-factor: The soil erodibility factor was calculated as an area-weighted average of all component soil types.
- USLE LS-factor: This factor is calculated from slope and slope length measurements by land use. Slope is evaluated by GIS analysis, and slope length is calculated as an inverse function of slope.
- USLE C-factor: The vegetative cover factor for each land use was evaluated following GWLF manual guidance, Wischmeier and Smith (1978), and Hession et al. (1997); and then adjusted after consultation with local NRCS personnel.
- Daily sediment buildup rate on impervious surfaces: The daily amount of dry deposition deposited from the air on impervious surfaces on days without rainfall, assigned using GWLF manual guidance.

Streambank Erosion Parameter Descriptions (Evans et al., 2003)

- % Developed land: percentage of the watershed with urban-related land uses – defined as all land in MDR, HDR, and COM land uses, as well as the impervious portions of LDR.
- Animal density: calculated as the number of beef and dairy 1000-lb equivalent animal units (AU) divided by the watershed area in acres.
- Curve Number: area-weighted average value for the watershed.
- K Factor: area-weighted USLE soil erodibility factor for the watershed.
- Slope: mean percent slope for the watershed.
- Stream length: calculated as the total stream length of natural perennial stream channels, in meters. Excludes any non-erosive hardened and piped sections of the stream.

- Mean channel depth (m): calculated from relationships developed either by the Chesapeake Bay Program or by USDA-NRCS by physiographic region, of the general form – $y = a * A^b$, where y = mean channel depth in ft, and A = drainage area in square miles (USDA-NRCS, 2005).

Supplemental Post-Model Processing

After modeling was performed on individual and cumulative sub-watersheds, the model output was post-processed in a Microsoft Excel™ spreadsheet to summarize the modeling results and to account for existing levels of BMPs already implemented within the North Fork and South Fork Pound River watersheds and to add in sediment loads from the Upper North Fork Pound River.

The extent and effect of existing agricultural BMPs was based on the DCR State Cost-Share Database. The DCR database tracks the implementation of BMPs within each state 1995 Hydrologic Unit Program (HUP) watershed. These data are then used by USEPA's Chesapeake Bay Program to calculate sediment reduction and pass-through fractions of the sediment load from each land use in each HUP for use with the Chesapeake Bay watershed model and with the Virginia biennial Statewide NPS Pollution Assessment (Yagow et al., 2002). Since the North Fork and South Fork Pound River watersheds are part of the Q13 watershed, the modeled land use categories used for this TMDL study were assigned sediment pass-through fractions for related land use categories from the Q13 watershed. In addition to the agricultural BMPs, mining sediment detention ponds were initially simulated as reducing existing extractive and reclaimed loads by 85% from all sub-watersheds containing sediment ponds, and then adjusted during calibration. The initial sediment pond efficiency was based on an approximate average of literature values on sediment pond efficiency estimates, which vary widely based on pond design, rainfall intensities, and sediment particle sizes. Sediment pond efficiencies range from 60% for urban wet ponds (Simpson and Weammert, 2009) to 91.8-96.7% for simulated detention of 17 ponds (USEPA, 1979), and 81-98% for small reservoirs (Dendy, 1974). Pass-through fractions (1 - sediment pond efficiency) were then calculated for extractive and reclaimed land uses. Modeled sediment loads from each agricultural and mining land use category were then multiplied by their respective pass-through fractions to simulate the reduced loads resulting from existing BMPs.

Representation of Sediment Sources

5.1.5. Surface Runoff

Pervious unit-area sediment loads (kg/ha) were modeled with GWLF using sediment detachment based on a modified USLE erosion algorithm, and a sediment delivery ratio to calculate loads at the watershed outlet, and were reported on a monthly basis by land use. Impervious area sediment loads were modeled using GWLF's exponential buildup-washoff algorithm.

5.1.6. Channel and Streambank Erosion

Streambank erosion was modeled within the GWLF model using a modification of the routine included in the AVGWLF version of the GWLF model (Evans et al., 2001). This routine calculates average annual streambank erosion as a function of percentage developed land, average area-weighted curve number (CN) and K-factors, watershed animal density, average slope, streamflow volume, mean channel depth, and total stream length in the watershed. Livestock population, which figures into animal density, was estimated based on the available pasture, hay and reclaimed areas in each sub-watershed times a stocking density of 0.378 animal units per acre (AU/acre).

5.1.7. Stormwater Sources

Construction Permits: There are no construction or industrial stormwater runoff discharges currently permitted in any of the North Fork and South Fork Pound River watersheds.

Gas & Oil Permits: Contributions from gas and oil operations in the watershed are transient, and stormwater E&S regulations require that any disturbed acreage during construction and drilling must be stabilized within 30 days. Currently there are 30 active wells, as listed previously in Table 2.18.

However, all but 3 of these wells are in the Upper North Fork Pound River watershed, which is not being simulated directly in this TMDL because of the mitigation effects of the North Fork Pound Lake. The DMME Division of Gas and Oil (DGO) estimates footprints of the pumping sites to average 50'-100' by 100'-200', or an average of approximately 0.26 acres each. Access road lengths vary widely but average around 0.5 miles in length and 20 feet wide for another 1.21 acres each. Sediment loads from both the pumping sites and the access roads are covered under the stormwater E&S permits, unless existing roads are used for access. Simulated loads from these sources are included under loads from the "barren" land use. For purposes of allocating an annual permitted load from this source and to accommodate anticipated growth, three new wells were estimated as being developed each year, based on the maximum disturbed acreage (15 ac.) from proposed wells in the Lick Creek TMDL (Yagow et al., 2007b), multiplied by the average monthly runoff from the "barren" land use category ([21.65 cm/yr] / [12 mo/yr] = 1.804 cm/mo), times the maximum permitted daily sediment concentration of 60 mg/L.

Coal Mining: Stormwater from an individual coal mining permit may be controlled by one or more NPDES-permitted sediment detention ponds, and individual sediment ponds may control runoff from parts of areas under more than a single mining permit. As of June 2007, there were ten (10) permitted sediment ponds in the Upper North Fork Pound River watershed that control runoff from different areas within a single mining permit. However, these are not modeled explicitly in this TMDL because the North Fork Pound Lake effectively disconnects these upstream sources from the observed downstream impairment. There are no NPDES-permitted sediment ponds in the Lower North Fork Pound River watershed. As of June 2007, there were twenty-six (26) permitted sediment ponds in the South Fork Pound River watershed that control runoff from different areas within seventeen different mining permits; one of these controls runoff from both the Phillips Creek and Donald Branch sub-watersheds just below their confluence. Individual sediment detention ponds are designed to capture 0.125 ac-ft of runoff per acre of disturbed land (barren and extractive land uses) for each storm event, and assume that the entire permitted acreage is disturbed. In the modeling, existing loads from these areas were represented by combinations of loads from a number of land use categories explained previously, and the sediment ponds were simulated with a calibrated reduction efficiency. In the phased TMDL calculation, the waste load allocation for permitted mining areas is based upon their permitted acreage, a daily maximum sediment concentration of 70 mg/L, and the annual average simulated runoff from the "extractive" land use – 19.04 cm/yr in the North Fork and South Fork Pound River. There were no active mining permits in Burns Creek. A summary of existing and future stormwater WLAs for sediment within the North Fork and South Fork Pound River watersheds are given in Table 5.4.

Table 5.4. Summary of Stormwater WLAs of TSS in the North Fork and South Fork Pound River Watersheds

Allocations can be found in the amendment attached to the end of this document: Amendment to the TMDL document, titled *North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments Wise County, Virginia* (Initially submitted to VADEQ April 2010)

5.1.8. Point Source

There are four permitted alternative domestic septic systems in the North Fork and South Fork Pound River watersheds. Permitted loads for all point source facilities were calculated as each system's design daily flow (MGD) times their permitted average TSS concentration. For facilities subject to monthly Discharge Monitoring Report (DMR) requirements, existing loads were calculated as the average daily flow times the average daily TSS concentration times 365 days/yr. The existing load from the domestic units was assumed equal to their permitted load. The permitted and existing loads for all point source dischargers are listed in Table 5.5.

Table 5.5. Point Source Discharge TSS Loads in North Fork and South Fork Pound River Watersheds

Allocations can be found in the amendment attached to the end of this document: Amendment to the TMDL document, titled *North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments Wise County, Virginia* (Initially submitted to VADEQ April 2010)

Accounting for Critical Conditions and Seasonal Variations

5.1.9. Selection of Representative Modeling Period

Selection of the modeling period was based on the availability of daily weather data and the need to represent variability in weather patterns over time in the watershed, with the beginning of the simulation period chosen to correspond with the beginning of electronic record-keeping by DMLR (January 1995). The model was run using a weather time series from April 1994 through December 2007, with the first 9 months used to initialize internal storages within the model. The remainder of the 13-year period was used to calculate average annual sediment loads in each of the Lower North Fork Pound River and South Fork Pound River watersheds, and the area-adjusted Burns Creek and Upper Dismal Creek watersheds.

5.1.10. Critical Conditions

The GWLF model is a continuous simulation model that uses daily time steps for weather data and water balance calculations. The period of rainfall selected for modeling was chosen as a multi-year period that was representative of typical weather conditions for the area, and included “dry”, “normal” and “wet” years. The model, therefore, incorporated the variable inputs needed to represent critical conditions during low flow – generally associated with point source loads – and critical conditions during high flow – generally associated with nonpoint source loads.

5.1.11. Seasonal Variability

The GWLF model used for this analysis considers seasonal variation through a number of mechanisms. Daily time steps are used for weather data and water balance calculations. The model also allows for monthly-variable parameter inputs for evapo-transpiration cover coefficients, daylight hours/day, and rainfall erosivity coefficients for user-specified growing season months.

Model Calibration

Model calibration is the process of adjusting model parameter values to improve the degree of agreement between simulated loads and loads calculated from monitored ("observed") data collected at a given point in a stream. Although GWLF was originally developed for use in non-gaged watersheds and, therefore, does not require calibration, hydrologic calibration has been recommended where observed flow data is available (Dai et al., 2000). Historically in Virginia, the GWLF model has been used to develop TMDLs to address sediment as a stressor in streams with benthic impairments. In these previous TMDLs, the successful restoration of the impaired stream was to be judged solely by the recovery of the benthic macro-invertebrate population and associated metrics, not by measured in-stream sediment loads. This is clearly not the case in South Fork Pound River, where permitted waste load allocations for sediment are closely monitored and tracked, and will serve as the basis for determining existing waste load allocations for new permits. Therefore, model calibration was performed for flow and sediment in watersheds corresponding to all three impaired segments, in order to obtain a greater correlation with available observed data, and to achieve a greater degree of consistency with DMLR's tracking software for Waste Load Allocations. A similar calibration was performed for Upper Dismal Creek.

Suitable calibration points were then researched within each impaired and reference watershed. Two points were identified in the South Fork Pound River watershed – one point just downstream from Phillips Creek (MPID 3420110) and another point closer to the South Fork Pound River outlet (MPID 0004381). Both of these monitoring points are DMLR monthly monitoring stations.

MPID 3420110 is located 0.63 miles downstream from the confluence of Phillips Creek and the former Donald Branch, and was used to calibrate Phillips Creek. The watershed above MPID 3420110 is 974.0 ha, including the 503.8 ha

Phillips Creek watershed. Monitoring at this station began in January 1995 and ran through October 2006, and included 116 observations with both flow and TSS concentrations.

MPID 0004381 is located 1.90 miles upstream from the confluence of the South and North Forks of Pound River, and was used to calibrate the South Fork Pound River. The watershed above MPID 0004381 is 3,993.5 ha, 87.9% of the entire South Fork Pound River, and includes Phillips Creek. Monitoring data was available at this station, however, with only 31 observations of flow and TSS concentration between February 2003 and March 2006. Since the watersheds formed by MPIDs 3420110 and 0004381 are nested watersheds, calibration was performed using the common period of – February 2003 through March 2006.

Within Upper Dismal Creek, the closest in-stream monitoring point – MPID 0004569 – is a monthly DMLR station located just below the confluence of Laurel Fork and Dismal Creek, 3.8 miles upstream from the outlet and representing 13.9% of the Upper Dismal Creek watershed area. The calibration previously performed for the Bull Creek Phased TMDL for the period of April 2005 through March 2007 was used for this watershed (Yagow et al., 2009).

Since little or no observed data were available at either the Burns Creek or Lower North Fork Pound River, the calibration adjustments made for the South Fork Pound River were applied to these watersheds.

The GWLF model was calibrated for both hydrology and sediment, based on the calibration sub-watersheds defined above. The hydrology parameters adjusted during calibration included: monthly evapotranspiration (ET) coefficients, the seepage coefficient, and the curve number by land use. The sediment parameters adjusted during calibration included: sediment pond efficiency by calibration sub-watershed, and the curve number by land use. The adjustments made to the calibration parameters are given in Table 5.6.

Table 5.6. Calibrated parameters and value adjustments

Calibration Adjustments	S F Pound River at MPID 3420110	S F Pound River at MPID 0004381	Upper Dismal Creek at MPID 4569
ET Dormant period MF*	1.00	1.00	1.05

ET Growing period MF*	1.00	1.00	0.97
Seepage coefficient	0.230	0.5075	0.074
Curve number MF*	0.775	0.740	0.765
Sediment pond efficiency	0.95	0.85	0.85

* MF = multiplication factor.

Calibration endpoints were set as unit-area flow and TSS load measures developed using the observed data at available DMLR monitoring stations in both the reference and TMDL watershed. Unit-area measures allow for comparison between watersheds of different sizes. The average unit-area flow and unit-area TSS loads from the observed data used as calibration targets and the results of simulated output from the calibrated model in each calibration sub-watershed are shown in Table 5.7. The median, rather than average, measures were used for calibrating South Fork Pound River, because median values are more closely related to baseflow conditions, and most of the observed data tended to reflect baseflow conditions.

Table 5.7. Observed and Simulated Unit-Area Measures for calibration sub-watersheds, Calibration Period

Median Unit-area Measures	S F Pound River at MPID 3420110		S F Pound River at MPID 0004381		Upper Dismal Creek at MPID 0004569*	
	Observed	Simulated	Observed	Simulated	Observed	Simulated
Flow (cfs/mi^2)	0.98	0.96	0.15	0.26	0.79	0.79
TSS Load (kg/ha-yr)	15.87	15.68	2.46	8.41	18.52	18.39

* Upper Dismal Creek was previously calibrated to average values, rather than medians.

The simulated unit-area flow and sediment loads (TSS) from calibration sub-watersheds above MPIDs 3420110 and 0004569, for the Phillips Creek and Upper Dismal Creek watershed models, respectively, were each within 2% of their respective observed median or average values. While there is a larger percentage difference between observed and simulated values for the calibration sub-watershed for the South Fork Pound River (MPID 0004381), both the flow and TSS load unit-area measures for the South Fork Pound River were considerably different from the other two watersheds. The observed South Fork

Pound River unit-area flow of 0.15 cfs/mi^2 is very low, with average unit-area flows in this area being typically on the order of 1.0 cfs/mi^2, as seen in the other two calibrated sub-watersheds, and influences the calculation of the observed "load". Since significant model parameter calibration adjustments had already been made which resulted in the simulated loads being reduced by nearly two orders of magnitude, and since the observed data was a limited set of primarily baseflow samples, the small remaining numeric differences between the observed and simulated median TSS unit-area loads in South Fork Pound River were considered acceptable. Overall, the calibrated models provide reasonable agreement between the simulated and observed results, given the short period of record of observed data and the limited range of observed flow conditions. Additional refinements are anticipated during the second phase on the TMDL, when additional monitoring data will be collected and will be available for additional model calibration efforts.

The calibration adjustments (shown in Table 5.6) were then applied to models of the full South Fork Pound River, Upper Dismal Creek, Lower North Fork Pound River, and Burns Creek watersheds and model simulations run for the 1995-2007 period.

GWLF Model Parameters

The GWLF parameter values evaluated for the three sets of impaired and reference watersheds are shown in Table 5.8 through Table 5.10. Table 5.8 lists the various watershed-wide parameters and their values, Table 5.9 displays the monthly variable evapo-transpiration cover coefficients, and Table 5.10 shows the land use-related parameters – runoff curve numbers (CN) and the Universal Soil Loss Equation's KLSCP product - used for erosion modeling.

Table 5.8. GWLF Watershed Parameters for the North Fork and South Fork Pound River TMDL and Reference Watersheds

GWLF Watershed Parameters	units	TMDL Lower North Fork Pound River	Reference Area-adjusted Burns Creek	TMDL Phillips Creek	Reference Area-adjusted Dismal Creek	TMDL South Fork Pound River	Reference Area-adjusted Dismal Creek
recession coefficient	(day^{-1})	0.2726	0.2726	0.2564	0.2564	0.0697	0.0697
seepage coefficient*	(day^{-1})	0.5075	0.5075	0.2300	0.0740	0.5075	0.0740
sediment delivery ratio		0.1916	0.1916	0.1911	0.1911	0.1447	0.1447
unsaturated water capacity	(cm)	12.39	11.90	12.05	12.00	11.93	12.00
erosivity coefficient (dormant season)		0.126	0.134	0.126	0.143	0.126	0.143
erosivity coefficient (growing season)		0.244	0.273	0.244	0.241	0.244	0.241
% developed land	(%)	5.2	0.7	0.0	2.8	0.8	2.8
no. of livestock	(AU)	0	2	0	3	132	27
area-weighted runoff curve number		69.94	71.84	74.52	70.09	74.74	70.09
area-weighted soil erodibility		0.200	0.200	0.200	0.208	0.200	0.208
area-weighted slope	(%)	37.14	24.92	52.57	41.72	38.13	41.72
aFactor		0.0001088	0.0000320	0.0000523	0.0000825	0.0000511	0.0000825
total stream length	(m)	5,363.0	7,253.2	3,483.8	6,965.2	34,897.1	62,836.2
Mean Channel Depth	(m)	0.361	0.361	0.370	0.370	0.697	0.697
* Calibrated value							

Table 5.9. GWLF Monthly Evapo-transpiration Cover Coefficients

Watershed	Apr	May	Jun	Jul*	Aug	Sep	Oct	Nov	Dec	Jan**	Feb	Mar
Lower North Fork Pound River	0.931	0.939	0.941	**0.941**	0.941	0.933	0.871	0.810	0.784	**0.766**	0.854	0.913
Area-adjusted Burns Creek	0.887	0.895	0.897	**0.897**	0.897	0.889	0.829	0.770	0.745	**0.728**	0.813	0.870
Phillips Creek	0.776	0.783	0.785	**0.785**	0.785	0.778	0.729	0.680	0.659	**0.645**	0.715	0.762
Area-adjusted Dismal Creek	0.948	0.953	0.954	**0.954**	0.954	0.949	0.910	0.872	0.855	**0.844**	0.899	0.937
South Fork Pound River	0.840	0.846	0.848	**0.848**	0.848	0.841	0.792	0.743	0.722	**0.709**	0.778	0.826
Area-adjusted Dismal Creek	0.948	0.953	0.954	**0.954**	0.954	0.949	0.910	0.872	0.855	**0.844**	0.899	0.937
* July values represent the maximum composite ET coefficients during the growing season, calibrated.												
** Jan values represent the minimum composite ET coefficients during the dormant season, calibrated.												

Table 5.10. GWLF Land Use Parameters for the North Fork and South Fork Pound River TMDL and Reference Watersheds – Existing Conditions

Landuse	Lower North Fork Pound		Area-adjusted Burns Creek		Phillips Creek		Area-adjusted Dismal Creek		South Fork Pound River		Area-adjusted Dismal Creek	
	KLSCP	CN*	KLSCP	CN*	KLSCP	CN*	KLSCP	CN*	KLSCP	CN*	KLSCP	CN*
HIGH_TILL	1.0034	59.4	0.1441	59.9	1.2984	62.4	1.2842	61.8	0.7061	59.8	1.2842	61.8
LOW_TILL	0.3975	58.8	0.0609	59.3	0.5485	61.9	0.5425	61.2	0.2983	59.2	0.5425	61.2
pasture2	0.0978	55.5	0.1061	56.0	0.1493	58.4	0.1145	57.8	0.1078	55.9	0.1145	57.8
hay	0.0632	55.0	0.0492	55.5	0.0693	57.9	0.0532	57.3	0.0501	55.4	0.0532	57.3
forest	0.0278	50.1	0.0235	50.8	0.0268	52.9	0.0292	52.4	0.0278	50.7	0.0292	52.4
transitional	1.3145	65.9	0.7642	66.1	1.3117	69.1	1.3830	68.3	1.2700	66.1	1.3830	68.3
extractive	2.9136	65.1	2.2538	65.1	3.7117	68.2	4.5791	67.3	3.7220	65.1	4.5791	67.3
AML	1.4012	65.1	0.9775	65.1	1.5835	68.2	1.6715	67.3	1.5810	65.1	1.6715	67.3
reclaimed	0.3941	61.5	0.2388	61.9	0.4369	64.6	0.5100	63.9	0.4381	61.8	0.5100	63.9
released	0.1540	55.5	0.1027	56.0	0.1880	58.4	0.2194	57.8	0.1889	55.9	0.2194	57.8
pur_LDR	0.0143	55.5	0.0106	56.0	0.0130	58.4	0.0186	57.8	0.0140	55.9	0.0186	57.8
pur_MDR	0.0083	55.5	0.0156	56.0	0.0122	58.4	0.0174	57.8	0.0111	55.9	0.0174	57.8
pur_HDR	0.0102	55.5	0.0041	56.0	0.0105	58.4	0.0183	57.8	0.0133	55.9	0.0183	57.8
pur_Trans	0.0138	55.5	0.0102	56.0	0.0146	58.4	0.0189	57.8	0.0146	55.9	0.0189	57.8
imp_LDR	0.0000	67.2	0.0000	67.3	0.0000	70.4	0.0000	69.6	0.0000	67.3	0.0000	69.6
imp_MDR	0.0000	72.5	0.0000	72.5	0.0000	76.0	0.0000	75.0	0.0000	72.5	0.0000	75.0
imp_HDR	0.0000	72.5	0.0000	72.5	0.0000	76.0	0.0000	75.0	0.0000	72.5	0.0000	75.0
imp_Trans	0.0000	72.5	0.0000	72.5	0.0000	76.0	0.0000	75.0	0.0000	72.5	0.0000	75.0

* Calibrated value

CHAPTER 6: MODELING PROCESS FOR TDS TMDL DEVELOPMENT

The TDS impairment only occurred in the two South Fork Pound River impaired stream segments. For the development of the total dissolved solids (TDS) TMDL for the South Fork Pound River watersheds, the relationship between pollutant sources and in-stream water quality was defined through computer modeling. In this chapter, the modeling process, input data requirements, and model calibration procedures for TDS are discussed.

Model Selection

The model selected for development of the TDS TMDLs was the Hydrological Simulation Program – FORTRAN (HSPF) model, version 12 (Bicknell et al., 2001; Duda et al., 2001).

The TMDL development process requires the use of a watershed-based model that integrates both point and nonpoint sources and simulates in-stream water quality processes. HSPF was used to model TDS transport and fate in all sub-watersheds of the South Fork Pound River. The ArcGIS™ 9.1 Geographic Information System (GIS) software was used to display and analyze landscape information for the development of inputs to HSPF.

The HSPF model simulates nonpoint source runoff and pollutant loadings, performs flow routing through streams, and simulates in-stream water quality processes. HSPF estimates runoff from both pervious and impervious parts of the watershed and stream flow in the channel network. The sub-module PWATER within the module PERLND simulates runoff, and hence, estimates the water budget on pervious areas (e.g., agricultural land). Runoff from impervious areas is modeled using the IWATER sub-module within the IMPLND module. The simulation of flow and routing through the stream network is performed using the sub-module HYDR within the module RCHRES. Transport of TDS on pervious and impervious land segments is simulated using the PQUAL (PERLND module) and IQUAL (IMPLND module) sub-modules, respectively. TDS was simulated in-stream as a conservative pollutant with load contributed from the various sources through surface runoff, interflow, groundwater, and direct discharge to the stream.

HSPF Model Development

As described previously, Lower Dismal Creek in Buchanan County was selected as the reference watershed for the South Fork Pound River watershed and the nested Phillips Creek sub-watershed. The 90th percentile of DEQ-monitored surface water TDS samples at station 6ADIS001.24 in Lower Dismal Creek was used to set the TMDL modeling concentration endpoint of 369 mg/L. In the absence of TDS water quality criteria, an assumption was made that the 90th percentile TDS concentration from a reference watershed with a healthy benthic community and a history of coal mining will set an achievable, effective TDS endpoint for South Fork Pound River TMDLs. Model development for all sub-watersheds in the South Fork Pound River was performed by assessing the sources of TDS in the watersheds, evaluating the necessary parameters for modeling, calibrating the model to observed data, and applying the model to simulate TDS loads.

The same nineteen sub-watersheds, as shown previously in Figure 5.1, were used to represent the spatial distribution of land uses and pollutant sources in the South Fork Pound River watersheds.

The majority of TDS loads are associated with current and historical mining activities within the watersheds. TDS are generated from active and abandoned mining areas within the watersheds are delivered to the stream through surface runoff, interflow, groundwater, and direct mine discharges. Residential sources of TDS within the watersheds include failing septic systems and straight pipes. Road salt applications are another source of TDS within the watershed that will be accounted for in the modeling process. In addition, TDS is also present from natural geologic sources in both the impaired and reference watersheds.

While all groundwater contains some background TDS, elevated levels are usually indicative of human activities. Background levels of TDS in groundwater for the Appalachian Plateau region of Virginia average 230 mg/L (USGS, 1997). Mining-related current and historical groundwater monitoring show elevated levels of TDS in groundwater near mining activities. Groundwater TDS concentrations may also be greater in shallower groundwater, which eventually returns to streams as interflow. Areas with valley fill may provide larger TDS loads from interflow because the flow of water percolating below the upper surface of the valley fill may cause an increase in the volume of interflow, and as a result, an increase in exposure time and soluble ion surface area interaction with the water. Although under natural conditions, interflow may contribute a substantial fraction of 'total groundwater' flow, in fractured valley fills, interflow may be considerably greater than ‘natural condition’ volumes, and contribute even more to the TDS load on a percentage basis.

Sources of TDS that contribute during surface runoff events include disturbed land, abandoned mine land, active surface mining areas, and road salt. Contributions of TDS to surface waters between storms may arise from interflow, groundwater, direct mine discharges, failing septic systems, and straight pipes.

There are 3 VPDES 1000-gpd general permit discharge facilities within the South Fork Pound River watershed. Nine NPDES permits issued by DMME for mining activities are currently active in Phillips Creek, and fourteen NPDES permits are active in the remainder of the South Fork Pound River watershed. There are 2 pre-law and 2 permitted co-mingled mine discharges in the watershed from underground mines. TDS monitoring was available from the pre-law sites, but not for the co-mingled discharges. Therefore, for the direct mine discharges, load was only calculated for the pre-law discharges. Limits for TDS are not part of current mining permits.

<u>Input Data Requirements</u>

The HSPF model requires a wide variety of input data to describe hydrology, water quality, and land use characteristics of any given watershed.

The different types and sources of input data used to develop the TDS TMDLs for the South Fork Pound River watersheds are discussed below.

6.1.1. Climatological Data

Daily temperature and hourly precipitation data for the North Fork and South Fork Pound River watersheds were obtained from the National Weather Service Cooperative Station 449125 at Wise, Virginia with missing data supplied from the North Fork Pound Lake (446173) and Abingdon (440021) stations. The Wise 3E station is located approximately 6.2 miles (10 km) southeast of the watershed. The period of record used for modeling was a 6.08-year period from January 2000 through January 2006. Detailed descriptions of the weather data and the procedure for converting the raw data into the required data set are presented in Appendix B.

6.1.2. Land Use

Land use categories were defined in a similar manner as for the GWLF modeling described in Section 5.3.2, with the exception that an impervious roads layer was added for simulation of road salt application.

<u>HSPF Parameter Evaluation</u>

The hydrology parameters required by HSPF were defined for every land use category. Required hydrology parameters are listed in the HSPF Version 12 User's Manual (Bicknell et al., 2001). Spatial analysis was performed using the ArcGIS™ geographical information system (GIS) to evaluate many of the HSPF input parameter values. Sub-watersheds were first delineated using GIS routines. Areas of individual land use categories were calculated using GIS within each sub-watershed and used to define the various PERLND (pervious land segments) and IMPLND (impervious land segments) model components. The spatially-defined sub-watershed/land use category areas were then used to evaluate other corresponding topographic and soils characteristics required by the model. Simplified representative stream reaches were then manually defined within each sub-watershed, and hydraulic stage-discharge relationships defined.

Since no flow gauging stations were available in the South Fork Pound River watershed, hydrologic calibration was performed on a surrogate watershed and the values of the selected calibrated parameters were applied to the South Fork Pound River model. The Cranes Nest River in Wise and Dickenson Counties was selected as the surrogate watershed, as it was one of the closest gauged stations and had previously been used as a surrogate for the Lick Creek TMDL modeling. Initial estimates for required hydrology parameters, outside of those evaluated from available digital spatial data, were evaluated for the surrogate watershed based on guidance in BASINS Technical Note 6 (USEPA, 2000a). Sub-watersheds were also created in Cranes Nest River at major confluences in order to represent the hydrology in the watershed. The stream reach in each sub-watershed requires a function table (FTABLE) to describe the relationship between water depth, surface area, volume, and discharge (Bicknell et al., 2001). Stream lengths and slopes were determined using GIS data. The procedures described in Staley et al. (2006) were used to characterize the reaches in the Cranes Nest River watershed using NRCS bankfull equations and digital elevation models, while FTABLEs for South Fork Pound River were generated from digital data and NRCS regional curves (http://wmc.ar.nrcs.usda.gov/technical/HHSWR/Geomorphic/index.html).

Representation of TDS Sources

The HSPF model was then configured for representation of TDS as a conservative generalized water quality constituent. Required water quality parameters are given in the HSPF User's Manual (Bicknell et al., 2001). TDS was simulated as contributing to stream loads from surface runoff, direct discharges to the stream, and through interflow and groundwater. TDS parameter values for the model were initially estimated, and calibration was then performed using periodic DMLR in-stream monitored concentrations at several points throughout the watershed.

6.1.3. Surface Runoff

Since TDS is associated with mining activities, TDS was simulated using buildup/washoff functions from extractive, abandoned mine land (AML), and barren land uses. Since monitored surface runoff data were not available, initial loading rates were estimated and then adjusted during the water quality calibration process.

An impervious land use was created for paved roads. Application of TDS from road salts was modeled as atmospheric deposition subject to surface runoff. Road salt was simulated as being applied on days with recorded snow events greater than 0.50 inches and maximum daily temperatures above 32°F. Runoff TDS loads were calculated as a daily time series and summarized as annual loads by sub-watershed. The length of named paved roads in each sub-watershed was calculated using TIGER™ data and an assumed impervious width of 20 feet (2.424 ac/linear-mile). The Wise County office of the Virginia Department of Transportation (VDOT) estimated that 350 pounds of road salt was applied per linear mile of paved road on days with recorded snow events. A monthly time series of TDS loads was generated within the watershed from NCDC daily surface data (Station 446173) for days with applicable snow events and then disaggregated to hourly loads. Hourly TDS loads were then calculated from this time-series as 350 lb/mi divided by 2.424 ac/linear-mile and 24 hrs/day (6.0156 lbs/ac-hr) and multiplied by the area of paved roads in each sub-watershed.

6.1.4. Interflow and Groundwater

The spatial variability of interflow TDS concentrations contributing to the South Fork Pound River were simulated by land use and determined through calibration.

In the South Fork Pound River sub-watersheds, groundwater TDS concentrations were represented by times-series based on DMLR groundwater monitoring data by sub-watershed. Each time-series was created from the existing network of DMLR sampling sites and adjusted with calibration multiplication factors. In the South Fork Pound River, groundwater TDS concentrations were initially estimated from monthly average concentrations within each sub-watershed for the period – January 1995 through September 2006. Groundwater TDS concentrations in sub-watersheds were initially estimated by averaging monthly DMLR monitoring from all available data – groundwater, in-stream, and NPDES. However, since these groundwater estimates correlated poorly with in-stream TDS concentrations in downstream segments, monthly groundwater concentrations were instead assigned a moving 4-month average of in-stream concentrations. Where sufficient data were available, interpolation was performed to estimate TDS concentrations in months with missing data. Sub-watersheds without monitored data, or with missing data at the beginning or ending of the period, were assigned concentrations for each month, either from a neighboring watershed, or as an average from several neighboring watersheds. The monthly time-series for each sub-watershed was then adjusted during calibration. The time-series multiplication factors for the 2000-2006 simulation period ranged from 0.2 to 1.0, and the adjusted monthly concentrations ranged from 46 to 2,258 mg/L, with an overall average TDS concentration of 907 mg/L.

6.1.5. Direct Discharge Sources

There are two DMLR-permitted co-mingled mine discharges from underground mines with monitored flow (MPIDs 0005061 and 3404547) and two pre-law mine discharges with monitored flow and TDS concentrations (MPIDs 3470248 and 3470286) located within the South Fork Pound River watershed. Flow and concentration data for these discharges were accounted for in HSPF as time-series input from MUTSIN files.

Septic system effluent loads of TDS were simulated from areas in South Fork Pound River without sewer access. The number of houses per sub-watershed was estimated from USGS 7.5-min topographic maps, with older homes defined as those structures that did not show up as photo-revised additions (approximately after 1967). Each household was classified into three age categories (pre-1969, 1970-1989, and post-1990) based on housing categories available in the 2000 census data. The population of the South Fork Pound River watershed is approximately 626, with 76 of those currently served by the sewer system operated by the Town of Pound. The population in the Phillips Creek watershed is included in the above numbers, but is negligible. The TDS concentration in residential effluent was simulated as 500 mg/L (USEPA, 2007). The TDS concentration from failing septic systems was simulated as 425 mg/L, estimated as half the difference between straight pipes and effluent concentrations from normally functioning septic systems (350 mg/L; USEPA, 2007). The numbers of houses with straight pipes were estimated from census data. The numbers of failing septic systems were based on estimates of failure rates in the three age categories as 20, 5, and 1%, respectively (based on personal communication with R.B. Reneau, 3 December 1999, Blacksburg, Virginia). The model, therefore, represents TDS in the effluent from older systems with potential maintenance problems (22), and from systems estimated to be discharging directly to streams via a straight pipe (49). TDS loads in effluent from normally functioning septic systems were assumed to be negligible.

Accounting for Critical Conditions and Seasonal Variations

6.1.6. Selection of Representative Modeling Period

Selection of the modeling period was based on the availability of daily weather data and the need to represent variability in weather patterns over time in the watershed. Since changes in land use during the simulation period are not readily simulated, the January 2000 through January 2006 period was selected for calibration because it represents the most recent period during which mining has occurred, and corresponds with available DMLR monitoring data related to the current mining activities and other land uses in the South Fork Pound River watershed.

6.1.7. Critical Conditions

The HSPF model is a continuous simulation model that uses hourly inputs of rainfall and climate to simulate runoff and pollutant loading, also on an hourly basis. The period of rainfall selected for modeling was the same 6.08-year period

(January 2000 through January 2006) used for calibration, and was considered to be representative of typical weather conditions for the area, and included “dry”, “normal” and “wet” years. The model, therefore, incorporated the variable inputs needed to represent critical conditions during low flow – generally associated with point source loads – and critical conditions during high flow – generally associated with nonpoint source loads.

6.1.8. Seasonal Variability

The HSPF model used for this analysis considers seasonal variation through a number of other mechanisms, as well. Some parameters varied monthly and additional parameters were entered as estimated or monitored time-series. TDS inputs in surface runoff were a direct response to seasonal weather variations. Groundwater concentrations were simulated as monthly averages by sub-watershed from DMLR-monitored data. Direct mine discharges were simulated as a time-series of approximately monthly DMLR flow and discharge measurements. Road salt applications were simulated as a time-series related to days with snow events. All of the model inputs simulated as direct measurement time-series capture as much seasonal variability as possible and minimize the uncertainty inherent in estimation by annual or overall averages.

Model Calibration and Validation

Model calibration is the process of adjusting parameters to improve the degree of agreement between model predictions and observed monitoring data during the calibration period. In this section, the procedures followed for calibrating the hydrologic and water quality (TDS) components of the HSPF model are discussed.

6.1.9. Hydrology

Because no continuous daily flow data were available on South Fork Pound River, detailed hydrology calibration and validation were performed for nearby Cranes Nest River. Observed daily flow data for Cranes Nest River were available from the USGS monitoring station 03208950, Cranes Nest River near Clintwood, VA. The HSPEXP decision support system developed by USGS

(Lumb et al., 1994) was used to calibrate the hydrologic portion of HSPF for Cranes Nest River. The default HSPEXP criteria for evaluating the accuracy of the flow simulation were used in the calibration for Cranes Nest River. These criteria are listed in Table 6.1.

Table 6.1. Default criteria for HSPEXP.

Variable	Percent Error Criteria
Total Volume	10%
50% Lowest Flows	10%
10% Highest Flows	15%
Storm Peaks	15%
Seasonal Volume Error	10%
Summer Storm Volume Error	15%

The hydrologic calibration period was August 1, 1989 to July 31, 1997. The hydrologic validation period was from May 1, 2001 to July 31, 2005. The output from the HSPF model for both calibration and validation was daily average flow in cubic feet per second (cfs). Calibration parameters were adjusted within the recommended range (USEPA, 2000a).

The simulated flow for both the calibration and validation matched the observed flow well, as shown in Figure 6.1 and Figure 6.2. The agreement with observed flows is further illustrated in Figure 6.3 and Figure 6.4 for a representative year and Figure 6.5 and Figure 6.6 for a representative storm. The agreement between the simulated and observed time series can be further seen through the comparison of their cumulative frequency curves (Figure 6.7 and Figure 6.8).

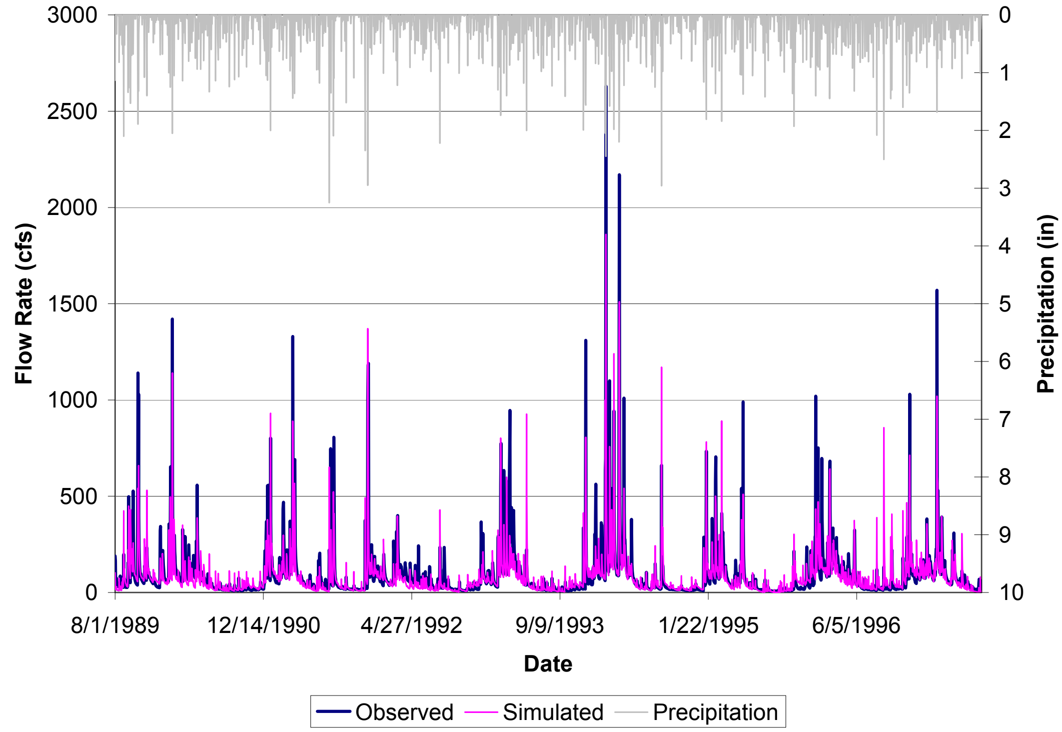

Figure 6.1. Observed and simulated flows and precipitation for Cranes Nest River for the calibration period.

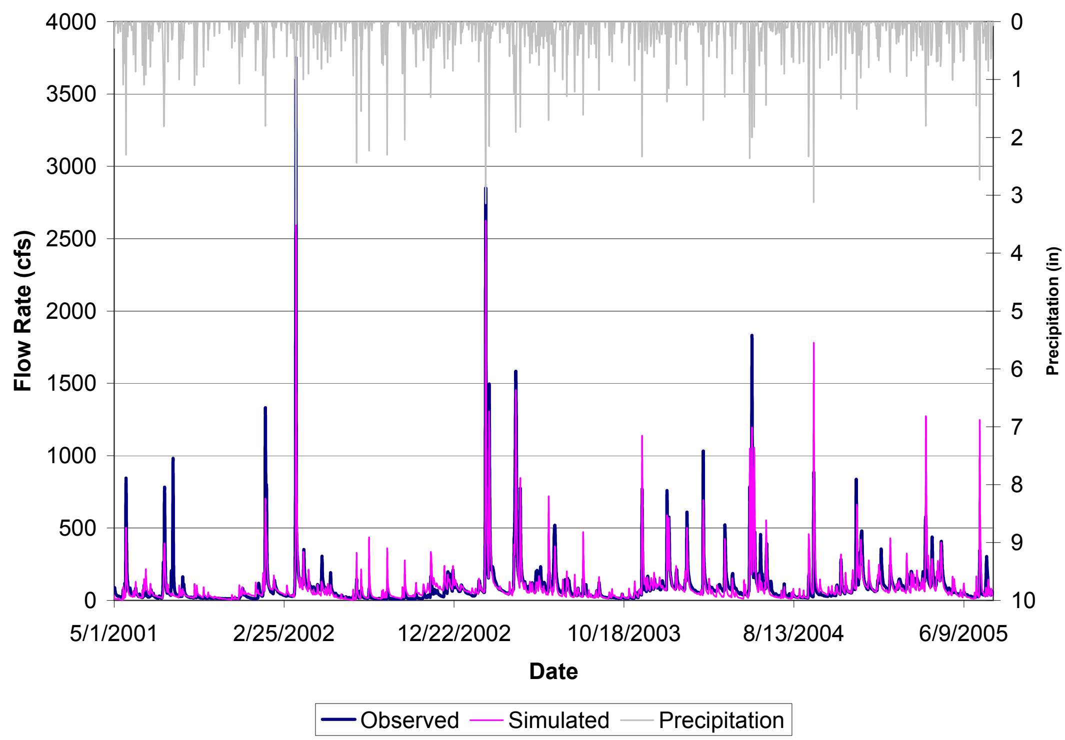

Figure 6.2. Observed and simulated flows and precipitation for Cranes Nest River during the validation period.

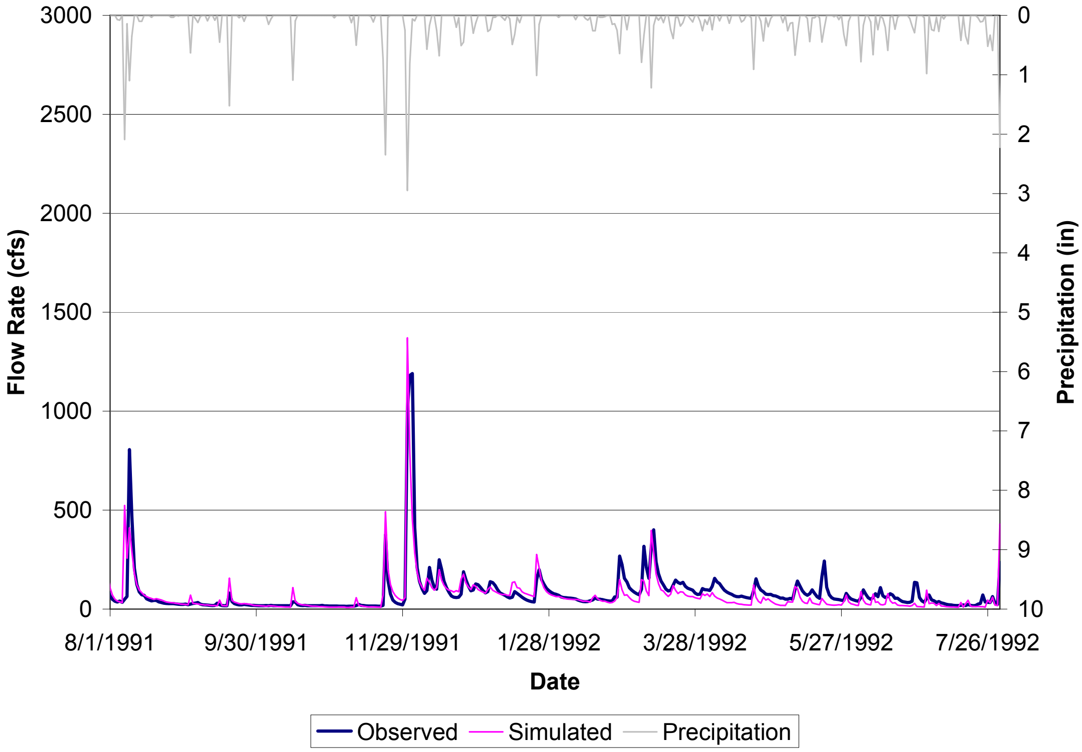

Figure 6.3. Observed and simulated flows and precipitation for a representative year in the calibration period for Cranes Nest River.

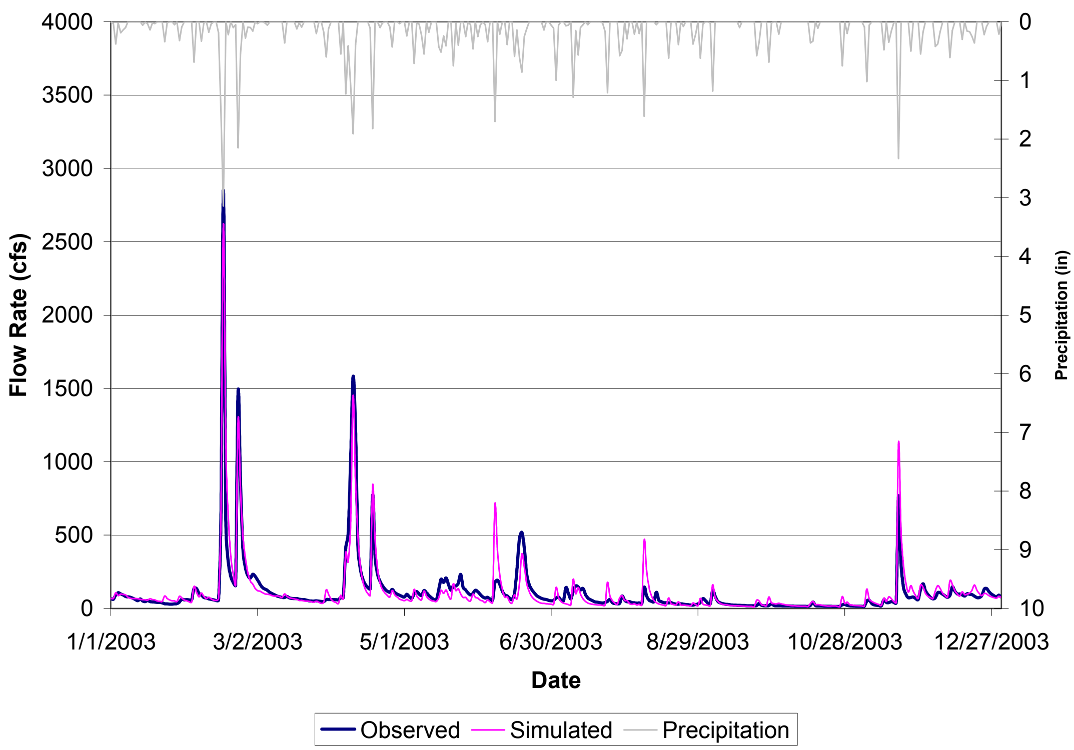

Figure 6.4. Observed and simulated flows and precipitation for Cranes Nest River during a representative year in the validation period.

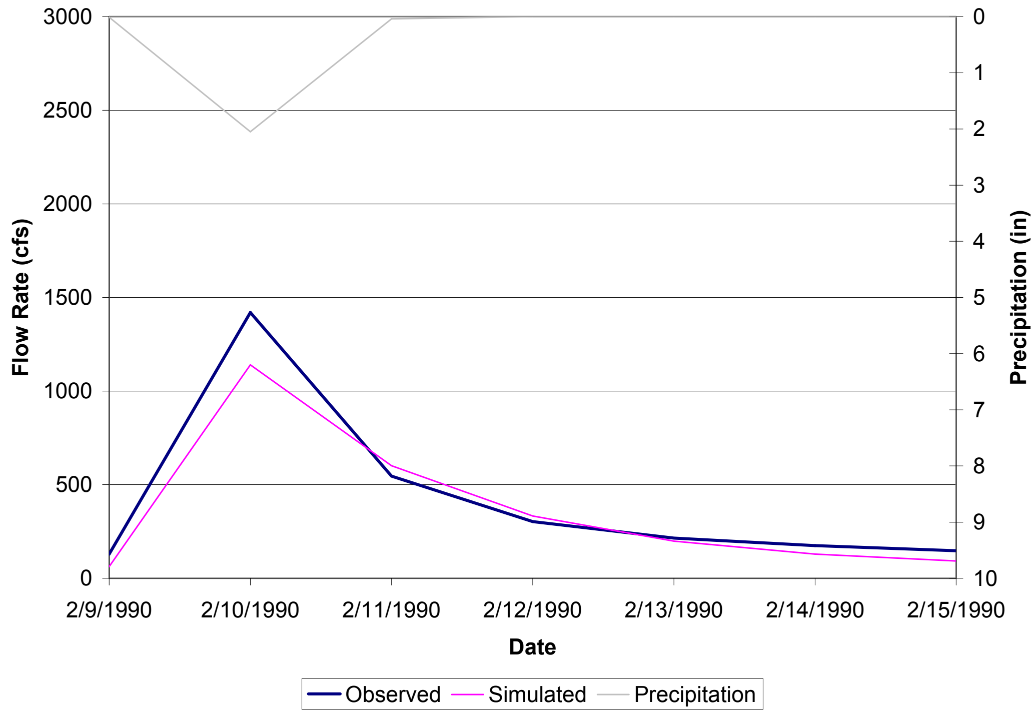

Figure 6.5. Observed and simulated flows and precipitation for Cranes Nest River for a representative storm in the calibration period.

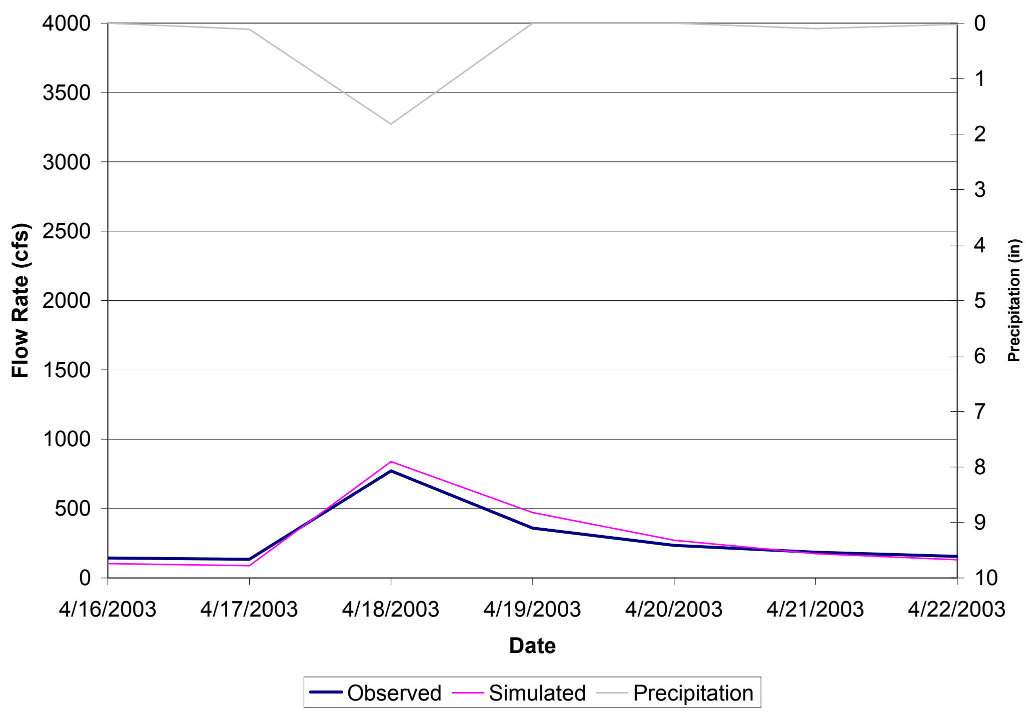

Figure 6.6. Observed and simulated flows, and precipitation for Cranes Nest River for a representative storm in the validation period.

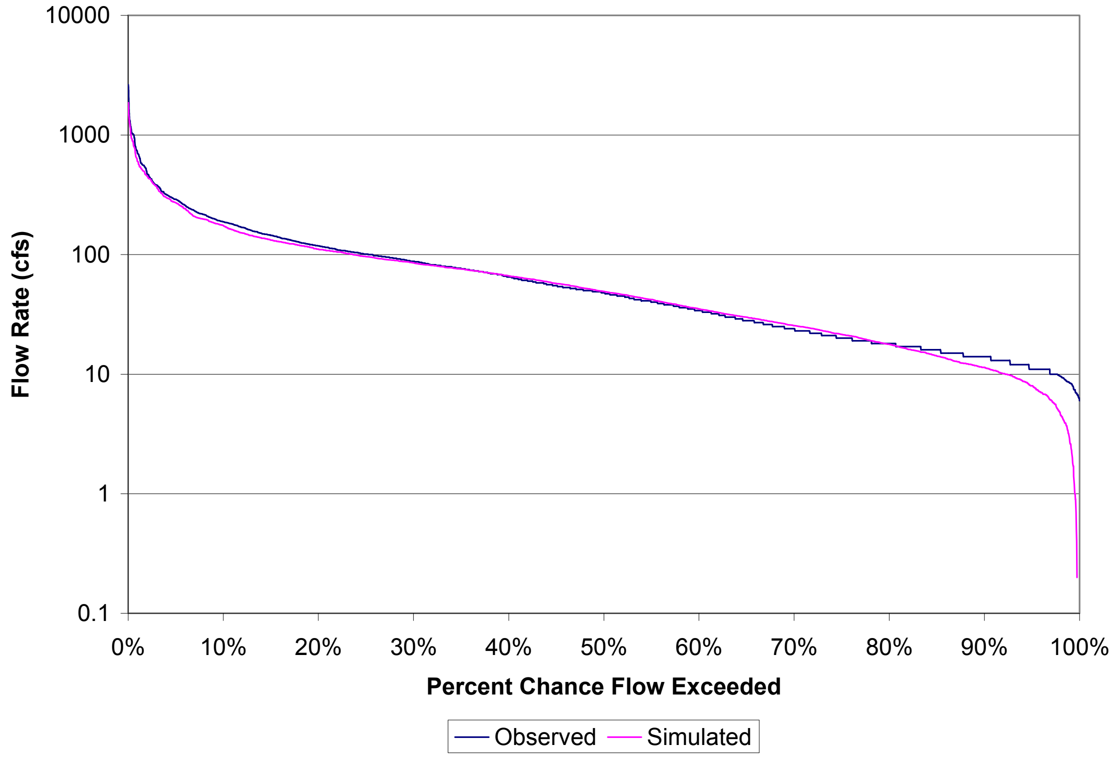

Figure 6.7. Cumulative frequency curves for the calibration period for Cranes Nest River.

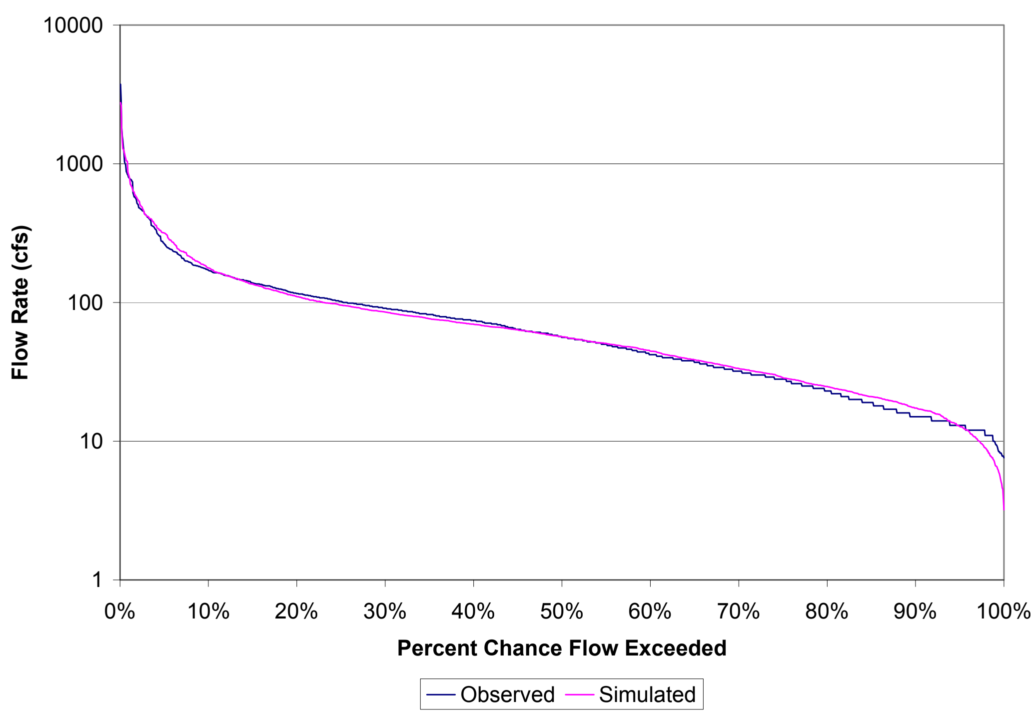

Figure 6.8. Cumulative frequency curves for the validation period for Cranes Nest River.

Selected diagnostic output from the HSPEXP program is listed in Table 6.2 and Table 6.3. All of the criteria were met for both the calibration and validation periods. The total winter runoff and total summer runoff errors are considered in the HSPEXP term 'seasonal volume error' (see Table 6.1). The errors for seasonal volume error were 1.9% for the calibration period and 3.0% for the validation period; both are within the required range of ±10%.

Table 6.2. Summary statistics for the calibration period for Cranes Nest River.

	Simulated	Observed	Error (%)	Criterion
Total Runoff (in)†	136.3	144.6	-5.8	10%
Average Annual Total Runoff (in)	17.04	18.08	-5.8	10%
Total of Highest 10% of flows (in) †	57.3	63.4	-9.6	15%
Total of Lowest 50% of flows (in) †	18.9	19.0	-0.3	10%
Total Winter Runoff (in) †	51.6	54.3	-5.0	na
Total Summer Runoff (in) †	15.5	16.0	-3.1	na
Coefficient of Determination, r^2	0.73			

†total for the 8-year calibration period
na = not applicable; these are not criteria directly considered by HSPEXP

Table 6.3. Summary statistics for the validation period for Cranes Nest River.

	Simulated	Observed	Error (%)	Criterion
Total Runoff (in)†	83.7	83.0	+0.8	10%
Average Annual Total Runoff (in)	19.7	19.5	+0.8	10%
Total of Highest 10% of flows (in) †	37.8	36.5	+3.6	15%
Total of Lowest 50% of flows (in) †	13.2	12.6	+4.7	10%
Total Winter Runoff (in) †	25.9	26.0	-0.3	na
Total Summer Runoff (in) †	16.6	16.2	+2.7	na
Coefficient of Determination, r^2	0.76			

†total for the 4.25-year validation period
na = not applicable; these were not criteria directly considered by HSPEXP

Flow partitioning for the Cranes Nest River hydrologic model calibration and validation is shown in Table 6.4. When the observed flow data were evaluated using HYSEP (Sloto and Crouse, 1996), the average baseflow indices for the calibration and validation periods were 0.55 and 0.53, respectively. The annual baseflow indices ranged from 0.42 to 0.62 for the calibration period and from 0.42 to 0.60 for the validation period. The baseflow indices for the simulated data are also presented in Table 6.4. The simulated baseflow index is close to the observed index for both periods, and both simulated baseflow indices fall within the observed range of baseflow indices.

Table 6.4. Flow partitioning for the calibration and validation periods for Cranes Nest River.

Average Annual Flow	Calibration	Validation
Total Annual Runoff (in)	17.04	19.69
Surface Runoff (in)	3.17 (19%)	4.17 (21%)
Interflow (in)	4.92 (29%)	6.45 (33%)
Baseflow (in)	8.95 (53%)	9.07 (46%)
Baseflow Index	0.53	0.46

All of the criteria were met for both the calibration and the validation periods. This indicates that the developed hydrologic model provides an acceptable prediction of Cranes Nest River flows. The final list of calibrated hydrologic parameters and their calibrated values for Cranes Nest River are listed in Table 6.5.

Table 6.5. Final calibrated hydrology parameters for Cranes Nest River.

Parameter	Definition	Units	FINAL CALIBRATION	FUNCTION OF…	Appendix C Table (if applicable)
PERLND					
LZSN	Lower zone nominal soil moisture storage	inches	4.0	Soil properties	
INFILT	Index to infiltration capacity	in/hr	0.186-0.286[a]	Soil and cover conditions	1
AGWRC	Base groundwater recession	none	0.965	Calibrate	
DEEPFR	Fraction of GW inflow to deep recharge	none	0.40	Geology	
CEPSC	Interception storage capacity	inches	monthly[b]	Vegetation	2
UZSN	Upper zone nominal soil moisture storage	inches	0.8	Soil properties	
INTFW	Interflow/surface runoff partition parameter	none	1.5	Soils, topography, land use	
IRC	Interflow recession parameter	none	0.5	Soils, topography, land use	
LZETP	Lower zone ET parameter	none	monthly[b]	Vegetation	3
RCHRES					
KS	Weighting factor for hydraulic routing		0.5		

[a]Varies with land use
[b]Varies by month and with land use

These parameters were then transferred to the South Fork Pound River watershed model. Since DMLR requires periodic in-stream TDS monitoring above and below various permitted mining sites around the South Fork Pound River watershed, these DMLR data were available for fine-tuning the hydrologic calibration, taking into consideration that these data reflected a limited range of rainfall-runoff response. The DMLR data were available at multiple points throughout the watershed which made it possible to account for differences in headwater and main channel contributions to flow during the fine-tuning.

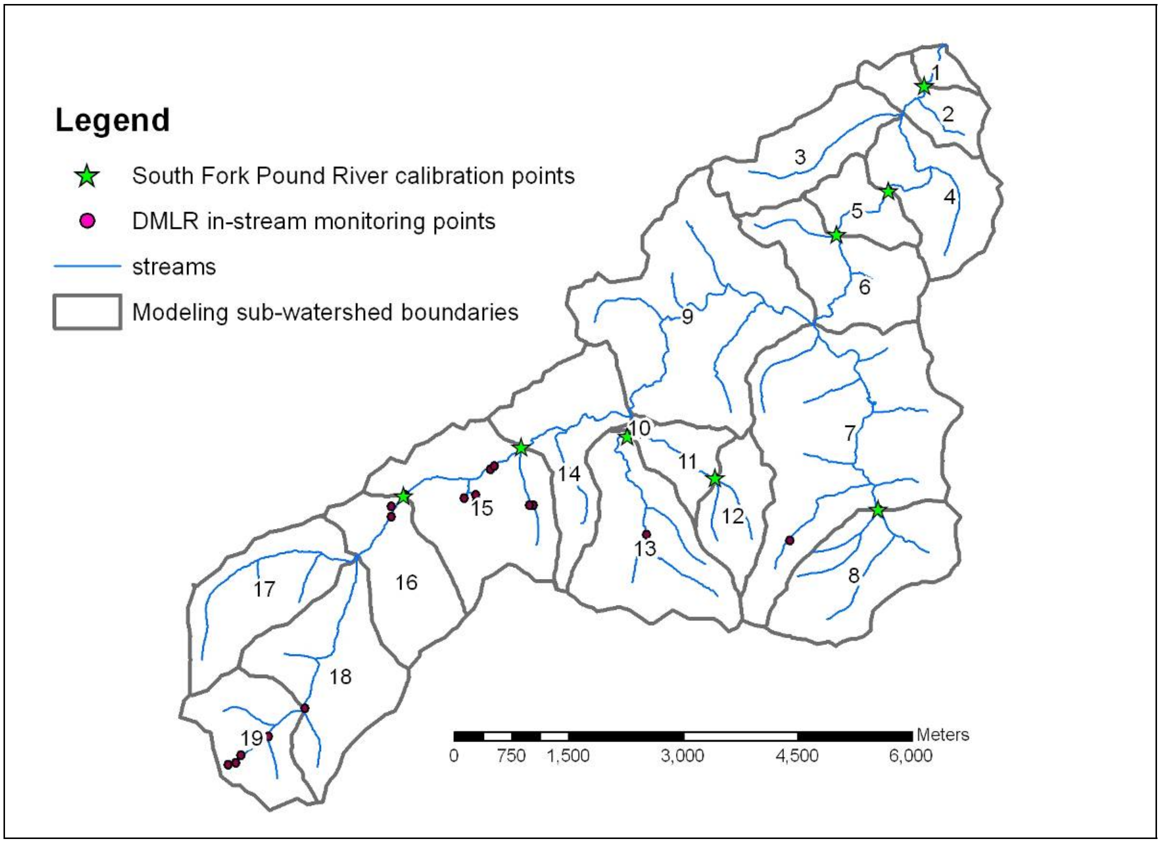

Figure 6.9. DMLR In-stream Monitoring and Selected Calibration Points in South Fork Pound River Watershed

Flows were then simulated with the South Fork Pound River model that incorporated the calibrated Cranes Nest River hydrologic parameter values. These simulated flows were then compared with observed flow data at select monitoring points around the watershed. The locations of these DMLR in-stream monitoring points are shown in Figure 6.9.

Two minor changes were made during the hydrologic calibration fine-tuning. One change was to increase the AGWRC parameter for forest land uses from 0.965 to 0.990 to eliminate the occurrence of non-typical no-flow days. This change conforms with guidance in BASINS Technical Note 6 (USEPA, 2000a). The second change was to adjust the DEEPFR parameter from a constant of 0.40 to values of 0.65 for sub-watershed 8, 0.80 for sub-watersheds 12-13, and 0.30 in sub-watersheds 1-7, to better match the observed DMLR-monitored flows.

The results are shown in Figure 6.10 through Figure 6.16. As can be seen from the figures, the simulated flows reasonably match the patterns and ranges of the observed points. Thus, the calibrated parameter set was deemed acceptable for use in the South Fork Pound River watershed. The hydrology fine-tuning resulted in a flow distribution with 9% arising from surface runoff, 20% from interflow, and 71% from groundwater during the simulated period, January 2000 through January 2006.

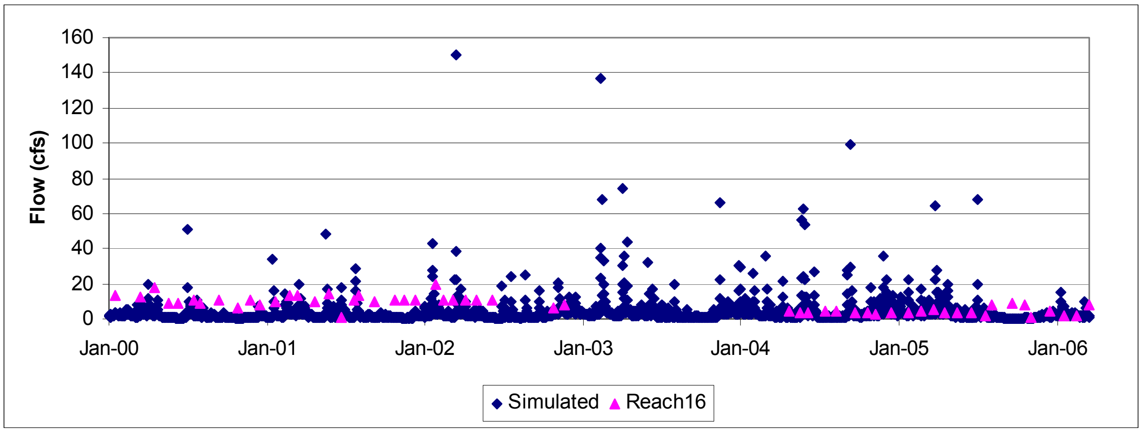

Figure 6.10. Calibrated simulated flow and DMLR observed flow in South Fork Pound River sub-watershed 16 (Upper South Fork Pound River).

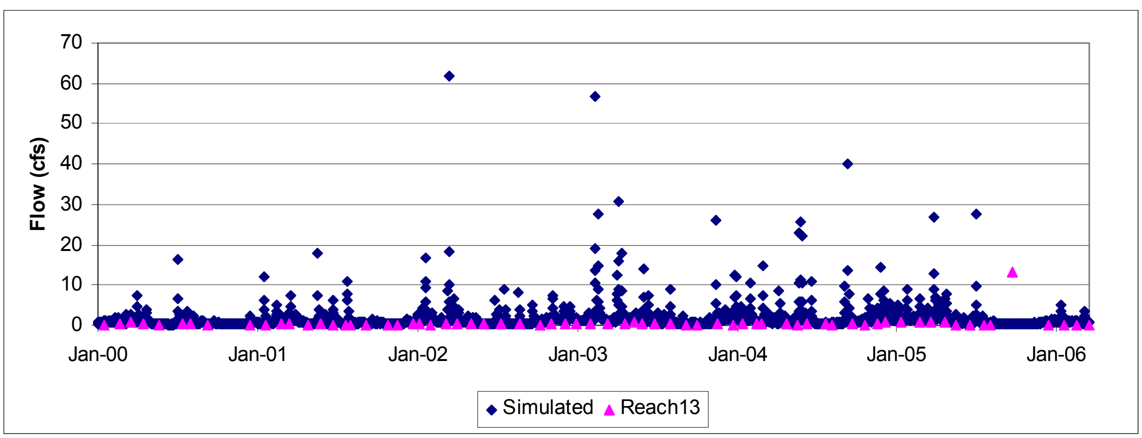

Figure 6.11. Calibrated simulated flow and DMLR observed flow in South Fork Pound River sub-watershed 13 (Rat Creek).

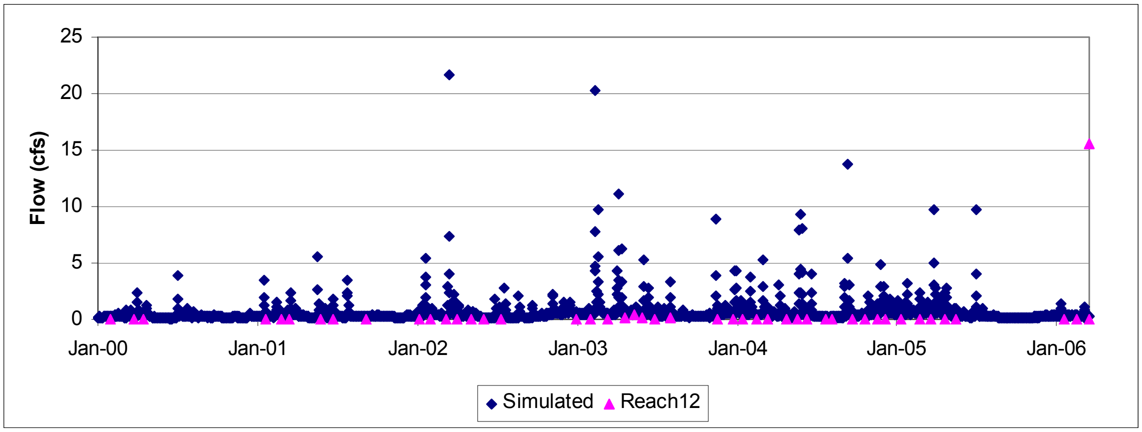

Figure 6.12. Calibrated simulated flow and DMLR observed flow in South Fork Pound River sub-watershed 12 (Upper Short Creek).

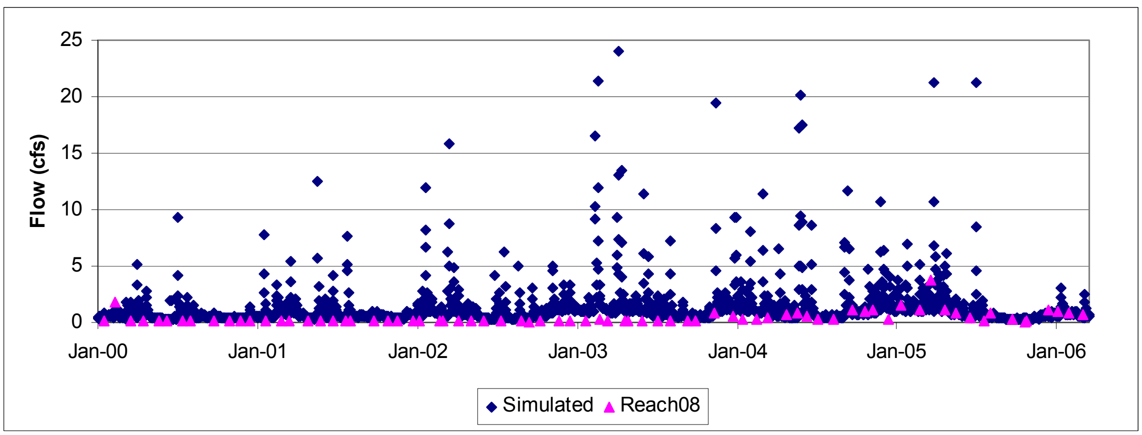

Figure 6.13. Calibrated simulated flow and DMLR observed flow in South Fork Pound River sub-watershed 8 (Upper Glady Fork).

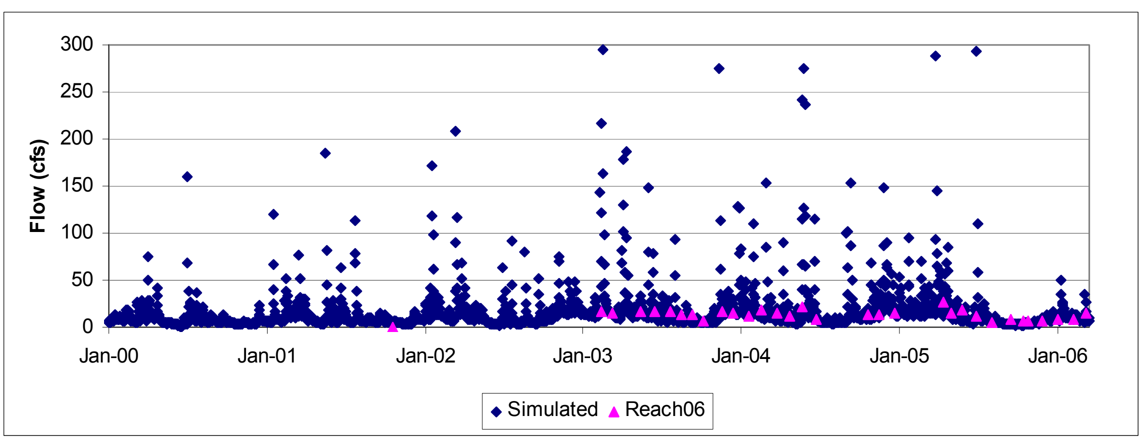

Figure 6.14. Calibrated simulated flow and DMLR observed flow in South Fork Pound River sub-watershed 6.

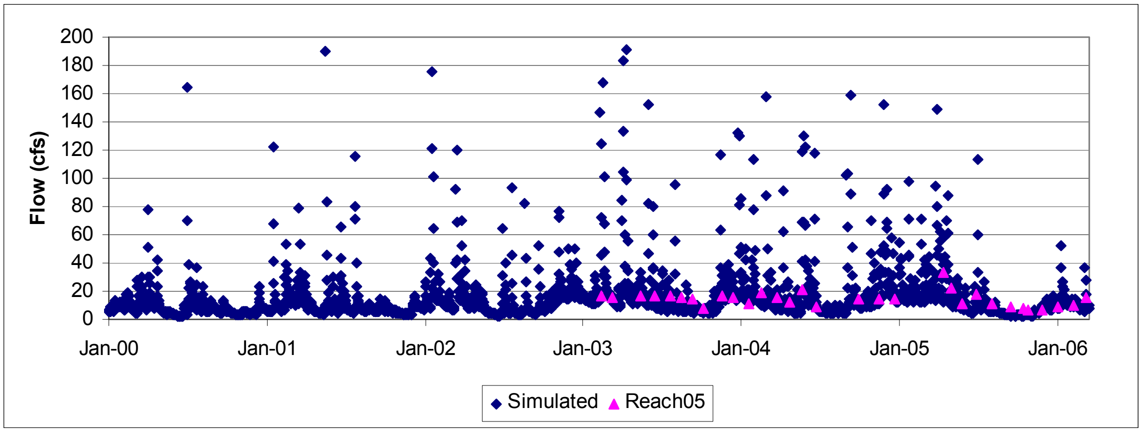

Figure 6.15. Calibrated simulated flow and DMLR observed flow in South Fork Pound River sub-watershed 5.

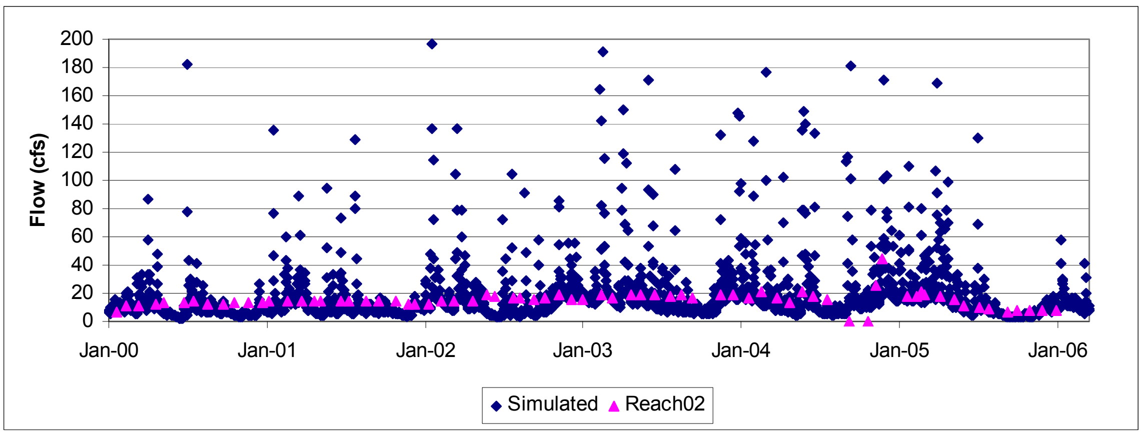

Figure 6.16. Calibrated simulated flow and DMLR observed flow in South Fork Pound River sub-watershed 2 (South Fork Pound River near outlet).

6.1.10. Water Quality (TDS)

Observed in-stream TDS concentrations from DMLR monitoring were also available at various points within the South Fork Pound River watershed. The same seven monitoring points used for hydrologic calibration were used for TDS calibration in the South Fork Pound River.

During TDS calibration, parameters within each watershed were adjusted to match the available DMLR TDS data collected in South Fork Pound River for the period January 2000 - January 2006. Inputs for TDS loads from road salt applications, failing septic systems, straight pipes and direct mine discharges were quantified as described in Section 6.5 and were not subjected to calibration. TDS load calibration focused on parameters affecting the remaining TDS load components – surface runoff, interflow, and groundwater. Three parameters control surface runoff loads – ACQOP, SQOLIM, and WSQOP. ACQOP is the rate of daily TDS buildup or availability on the land surface; SQOLIM is the maximum level of TDS load on the land surface at any given time; and WSQOP is the rate of surface runoff that will remove 90% of the surface buildup in any given time step. Surface runoff loads were only simulated for the extractive and reclaimed land uses. Additional calibration parameters included interflow TDS concentrations (IOQC) and groundwater concentrations (AOQC). The calibrated values and/or ranges for these parameters in the South Fork Pound River watershed are given in Table 6.6.

Table 6.6. TDS calibration parameters and values for South Fork Pound River

Parameter	Value/Range	Units	Spatially Variable	Temporally Variable
Pervious Land Segments				
ACQOP	200	lb/ac-day	constant	constant
SQOLIM	400	lb/ac-day	constant	constant
WSQOP	2.00	in/hr	constant	constant
AOQC	46 - 3,016	mg/L	by sub-watershed	monthly
IOQC	0.01436 - 0.04683 (230 - 750)	lb/ft3 (mg/L)	by land use and sub-watershed	constant
Impervious Land Segments				
CONS	144.4	lb/ac-day	roads	constant
SQOLIM	350	lb/ac-day	constant	constant
WSQOP	3.00	in/hr	constant	constant

The graphs comparing simulated and observed concentrations at the seven calibration points along South Fork Pound River are shown in Figure 6.17 to Figure 6.23.

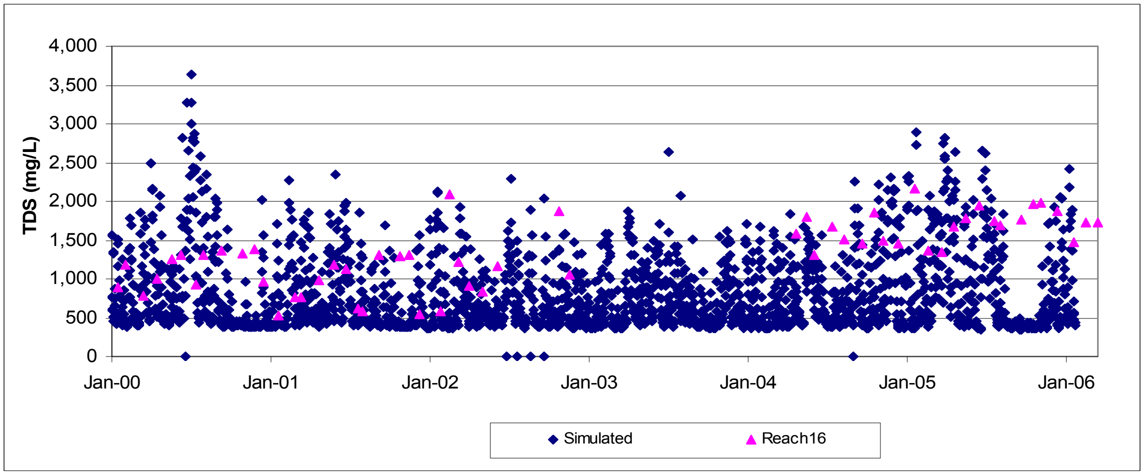

Figure 6.17. Simulated TDS concentrations and DMLR observed TDS concentrations in South Fork Pound River sub-watershed 16 after calibration.

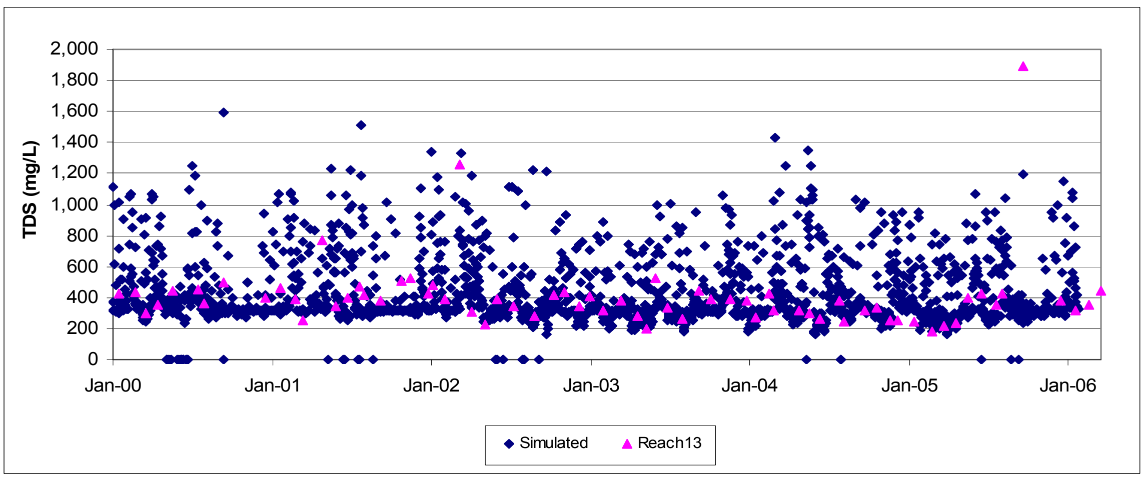

Figure 6.18. Simulated TDS concentrations and DMLR observed TDS concentrations in South Fork Pound River sub-watershed 13 (Rat Creek) after calibration.

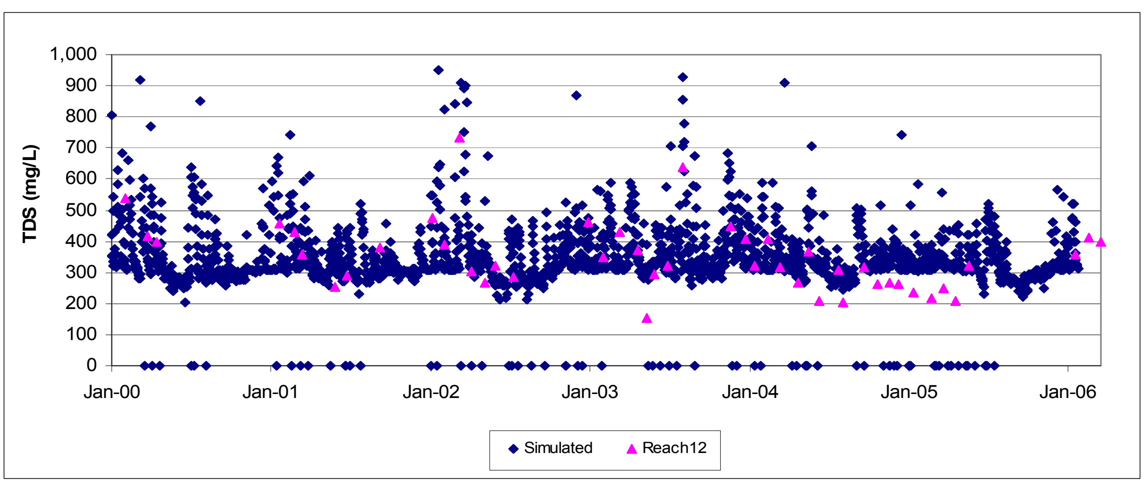

Figure 6.19. Simulated TDS concentrations and DMLR observed TDS concentrations in South Fork Pound River sub-watershed 12 (Upper Short Creek) after calibration.

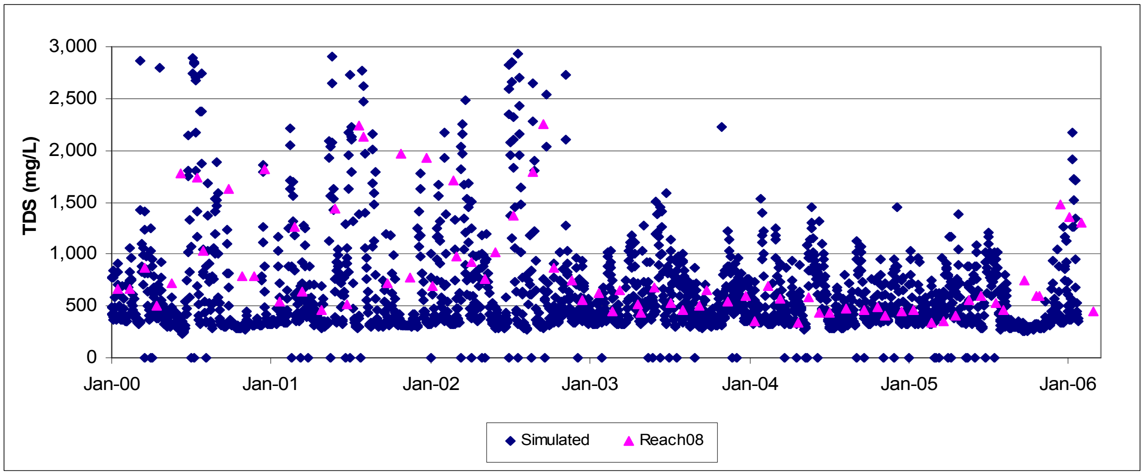

Figure 6.20. Simulated TDS concentrations and DMLR observed TDS concentrations in South Fork Pound River sub-watershed 8 (Upper Glady Fork) after calibration.

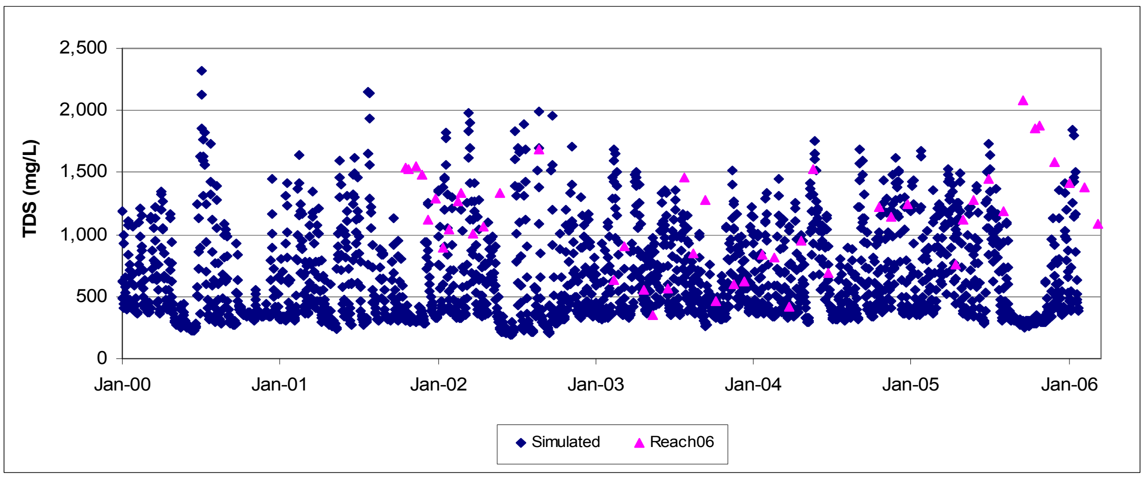

Figure 6.21. Simulated TDS concentrations and DMLR observed TDS concentrations in South Fork Pound River sub-watershed 6 after calibration.

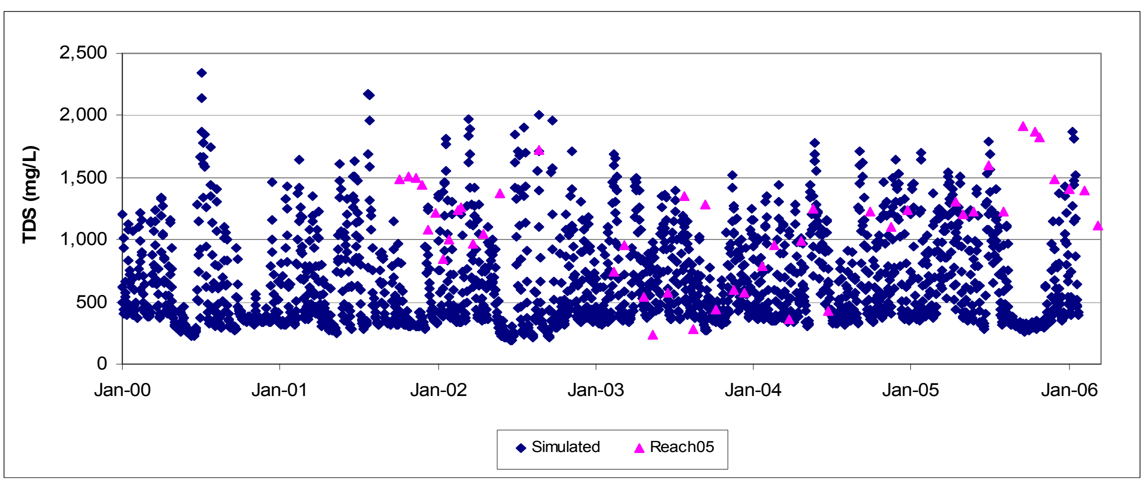

Figure 6.22. Simulated TDS concentrations and DMLR observed TDS concentrations in South Fork Pound River sub-watershed 5 after calibration.

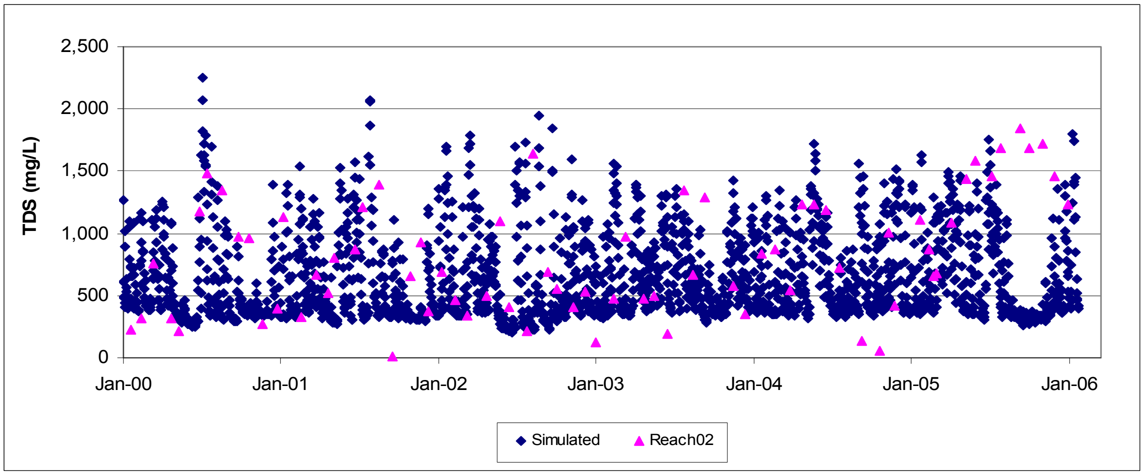

Figure 6.23. Simulated TDS concentrations and DMLR observed TDS concentrations in South Fork Pound River sub-watershed 2 (South Fork Pound River near outlet) after calibration.

A visual comparison of simulated and observed in-stream TDS concentrations and best professional judgment were used to assess when a reasonable model calibration had been achieved. Additionally, the range and average of TDS concentrations were considered during calibration. Table 6.7 shows the comparison of these statistics and the percentage match between simulated and observed average TDS concentrations at each calibration point. Taken together, the visual data comparison and the descriptive statistics indicate a reasonable calibration of this highly variable parameter.

Table 6.7. TDS calibration statistics in 7 sub-watersheds of South Fork Pound River

Sub-watershed Reach	Simulated		Observed		Sim Ave / Obs Ave
	Range (mg/L)	Average (mg/L)	Range (mg/L)	Average (mg/L)	(%)
Reach 16	510 - 1873	1,150	533 - 3104	1,405	81.9%
Reach 15	490 - 1879	1,079	96 - 2002	962	112.1%
Reach 13	63 - 17327	725	150 - 2906	433	167.5%
Reach 12	124 - 909	379	155 - 733	351	107.9%
Reach 8	220 - 2487	833	345 - 2258	837	99.6%
Reach 6	382 - 1607	969	356 - 2076	1,138	85.2%
Reach 5	383 - 1622	974	238 - 1910	1,112	87.6%
Reach 2	370 - 1438	864	12 - 1839	814	106.2%

Although the total TDS loads from the watershed appear reasonable in relation to observed in-stream concentrations, the distributions among the various pathways of surface transport, interflow, and groundwater contributions to stream loads and between permitted mining and AML sources are somewhat uncertain. Loads from the other sources of TDS – residential, road salt, and pre-law mining – have been estimated with a degree of confidence. The parameters from the remaining sources of TDS in the watershed – active mining and AML land uses – were initially evaluated from available literature sources; however, only limited information was available to differentiate between these sources. Because of the uncertainties in the exact distribution of these loads, a phased TMDL was determined to be appropriate for the TDS stressor in South Fork Pound River. To calculate TDS loads generated for each mining permit, the model was first run with loads calculated from individual sub-watersheds with TDS sources from AML, road salt, pre-law mine discharges, residential septic source, and background interflow contributions turned off. The resulting sub-watershed TDS loads attributable to permitted mining sources were then apportioned to permits within each sub-watershed on an area-basis. The load for each permit was then summed from its area-weighted portions in each sub-watershed. Since some sub-watersheds did not include permitted mining area, loads generated in these areas were included as background loads.

<u>HSPF Model Parameters</u>

A summary of the hydrologic parameter values used for South Fork Pound River are listed in Table 6.8. Complete listings of HSPF parameters that vary by month or by land use are included in Appendix C.

Table 6.8. Summary of hydrologic parameters and values for South Fork Pound River

Parameter	Definition	Units	Values	Function of…	Appendix C Table (if applicable)
PERLND					
PWAT-PARM2					
FOREST	Fraction forest cover	none	1.0 forest, 0.0 other	Forest cover	
LZSN	Lower zone nominal soil moisture storage	inches	4.0	Soil properties	
INFILT	Index to infiltration capacity	in/hr	0.186-2.0[a]	Soil and cover conditions	1
LSUR	Length of overland flow	feet	30-200[a]	Topography	1
SLSUR	Slope of overland flowplane	none	0.13-0.50[a]	Topography	1
KVARY	Groundwater recession variable	1/in	0.0	Calibrate	
AGWRC	Base groundwater recession	none	0.99 forest, 0.965 other	Calibrate	
PWAT-PARM3					
PETMAX	Temp below which ET is reduced	deg. F	40	Climate, vegetation	
PETMIN	Temp below which ET is set to zero	deg. F	35	Climate, vegetation	
INFEXP	Exponent in infiltration equation	none	2	Soil properties	
INFILD	Ratio of max/mean infiltration capacities	none	2	Soil properties	
DEEPFR	Fraction of GW inflow to deep recharge	none	0.40	Geology	
BASETP	Fraction of remaining ET from baseflow	none	0.12	Riparian vegetation	
AGWETP	Fraction of remaining ET from active GW	none	0.10	Marsh/wetland s ET	
PWAT-PARM4					
CEPSC	Interception storage capacity	inches	monthly[b]	Vegetation	7
UZSN	Upper zone nominal soil moisture storage	inches	0.8	Soil properties	
NSUR	Manning's n (roughness)	none	0.011-0.6[a]	Land use, surface condition	3
INTFW	Interflow/surface runoff partition parameter	none	1.5	Soils, topography, land use	
IRC	Interflow recession parameter	none	0.5	Soils, topography, land use	
LZETP	Lower zone ET parameter	none	monthly[b]	Vegetation	8
IMPLND					
IWAT-PARM2					
LSUR	Length of overland flow	feet	116	Topography	
SLSUR	Slope of overland flowplane	none	0.22	Topography	
NSUR	Manning's n (roughness)	none	0.08	Land use, surface condition	
RETSC	Retention/interception storage capacity	inches	0.100	Land use, surface condition	

[a]Varies with land use
[b]Varies by month and with land use

CHAPTER 7: TMDL ALLOCATIONS

The objective of a TMDL is to allocate allowable loads among different pollutant sources so that appropriate actions can be taken to achieve water quality standards (USEPA, 1991). The stressor analysis indicated that a combination of sediment and total dissolved solids (TDS) were the "most probable stressors" in each of the watersheds corresponding to the three impaired segments (Yagow et al., 2007a), and therefore, a TMDL was developed for each identified stressor related to each impaired segment .

North Fork and South Fork Pound River Phased Sediment TMDLs

7.1.1. Background

Three stream segments within the North Fork and South Fork Pound River watersheds were assessed as having benthic impairments based on biological monitoring within the watershed. The impairment in the Lower North Fork Pound River segment (VAS-Q13R-02) was based on biological monitoring station PNK000.08; the impairment in the South Fork Pound River (VAS-Q13R-01) based on monitoring at stationPNS000.40; and the impairment in Phillips Creek and the former Donald Branch (VAS-Q13R-04) was based on monitoring at station PNS008.73. Sediment was declared to be one of the most probable stressors in each watershed, so individual sediment TMDLs were developed for each of the three impaired segments. The sediment TMDL to address the benthic impairments in these watersheds were developed using a reference watershed approach, with Burns Creek in Wise County selected as the reference watershed for the Lower North Fork Pound River segment, and Upper Dismal Creek in Buchanan County selected as the TMDL reference watershed for the nested South Fork Pound River and the Phillips Creek segments.

7.1.2. TMDLs and Existing Conditions

Sediment loads were simulated with the GWLF model and annual average loads calculated over the 13-yr simulation period. Table 7.1 shows average annual sediment loads (t/yr) and unit-area sediment loads (t/ha) by source category for watersheds corresponding to each of the impaired segments and their reference watersheds.

Table 7.1. Existing sediment loads (t/yr) and unit-area sediment loads (t/ha) in North Fork and South Fork Pound River watersheds and corresponding area-adjusted Reference Watersheds

Modeled Land Use Categories	Lower North Fork (LNF) Pound River		LNF Area-adjusted Burns Creek		Phillips Creek (PC)		PC Area-adjusted Upper Dismal Creek		South Fork (SF) Pound River**		SF Area-adjusted Upper Dismal Creek	
	(t/yr)	(t/ha)	(t/yr)	(t/ha)	(t/yr)	(t/ha)	(t/yr)	(t/ha)	(t/yr)	(t/ha)	(t/yr)	(t/ha)
Cropland	--		0.9	1.4	0.5	5.4	0.2	3.7	37.3	1.9	1.3	2.8
Pasture	3.7	0.2	0.3	0.1	0.3	0.4	1.7	0.2	46.7	0.2	11.4	0.2
Hay	0.3	0.1	0.2	0.2	0.0	0.2	--		4.2	0.1	--	
Forest	52.6	0.1	53.5	0.1	52.1	0.2	72.4	0.2	315.4	0.1	494.4	0.1
Barren	263.1	12.6	304.7	4.5	165.0	15.9	54.2	13.5	2,125.0	10.3	370.4	10.2
Mining												
Extractive	11.9	38.4	--		222.4	1.6	4.2	6.7	1,270.1	2.0	28.9	5.1
Reclaimed	--		--		2.4	0.2	0.3	0.6	27.1	0.2	1.9	0.5
Released	--		--		2.2	1.8	0.8	1.7	12.9	1.3	5.4	1.3
AML	--		--		77.4	18.2	390.3	16.2	4,011.9	13.2	2,666.1	12.3
Low Density Residential	0.7	0.1	0.2	0.1	--		1.3	0.1	1.3	0.1	9.0	0.1
Medium Density Residential	0.3	0.1	--	0.1	--		0.0	0.1	0.0	0.0	0.0	0.1
High Density Residential	1.1	0.1	0.0	0.0	--		0.1	0.1	1.2	0.1	1.1	0.1
Transportation	0.6	0.1	--	0.1	--		0.4	0.1	0.5	0.1	3.0	0.1
Channel Erosion	2.1		0.2		0.1		0.6		0.5		28.3	
Outflow from Dam	344.5											
Total Load	**680.8**		**359.9**		**522.5**		**526.4**		**7,854.1**		**3,621.1**	

** Includes loads from Phillips Creek.

The phased sediment TMDL for each impaired segment in the North Fork and South Fork Pound River was calculated using the following equation:

$$TMDL = \sum WLA + \sum LA + MOS$$

where $\sum WLA$ = sum of the wasteload (permitted) allocations;

$\sum LA$ = sum of load (nonpoint source) allocations; and

MOS = margin of safety.

The phased sediment TMDL for each impaired watershed was calculated as the average annual sediment load from their corresponding area-adjusted reference watershed for existing conditions (Table 7.1).

Annual waste load allocations were assigned to the stormwater permits in Lower North Fork and South Fork Pound River watersheds based on the area of the facility or disturbance, the permitted maximum daily concentration of TSS, and the average annual simulated runoff from the corresponding land use, as detailed in Table 5.4. A future growth allowance is also included for a 10% increase in permitted mining area and a corresponding 10% increase in allocated load. This increase in sediment allocation was allocated to the tributary sub-watersheds as a fraction of their current permitted loads. A future growth allocation was also included for stormwater E&S sediment loads from anticipated new well construction. The WLA was calculated as the sum of permitted loads from existing permitted stormwater discharge facilities and from projected future stormwater sediment loads from expansion of the coal mining and gas and oil industries.

An explicit MOS of 10% was used in the sediment TMDL to reflect the uncertainty involved in developing a TMDL. The LA was calculated as the TMDL minus the MOS minus the WLA. The TMDL and its component loads are shown in Table 7.2 for all three impaired segments.

Table 7.2. North Fork and South Fork Pound River Phased Sediment TMDLs (t/yr)

Allocations can be found in the amendment attached to the end of this document: Amendment to the TMDL document, titled *North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments Wise County, Virginia* (Initially submitted to VADEQ April 2010)

7.1.3. Allocation Scenarios

For development of the allocation scenarios: pasture, hay, and urban grass were grouped into the "pasture/hay" category; and all residential and transportation sources were also grouped together as "residential/urban". Three alternative allocation scenarios were developed for each impaired segment, as shown respectively in Tables 7.3, 7.4, and 7.5.

In the Lower North Fork Pound River, TMDL Alternative 1 represents equal % reductions from all source categories. TMDL Alternative 2 requires equal % reductions from all sources except from outflow from the dam, which shows that the TMDL cannot be met without some reductions from outflow from the dam. TMDL Alternative 3 divides the percent reduction equally between the two largest load categories – barren and outflow from the dam.

Table 7.3. Phased Sediment TMDL Load Allocation Scenarios for Lower North Fork Pound River

Allocations can be found in the amendment attached to the end of this document: Amendment to the TMDL document, titled *North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments Wise County, Virginia* (Initially submitted to VADEQ April 2010)

The sediment TMDL for the Lower North Fork Pound River watershed is 359.9 t/yr, with a modeling target equal to the TMDL minus the MOS (359.9 – 36.0 = 323.9 t/yr), requiring an overall reduction of 52.4% from existing loads. The Lower North Fork Pound River sediment TMDL was developed to meet the sediment load of the area-adjusted TMDL reference watershed defined by station 6ABUC000.24 on Burns Creek. From the three alternative scenarios explored, Alternative 3 is recommended as the starting point for consideration by a local watershed steering committee during the implementation phase.

In Phillips Creek, TMDL Alternative 1 represents equal % reductions from all significant source categories. TMDL Alternative 2 requires taking equal % reductions from the two largest non-permitted sources, while Alternative 3 first reduces AML and takes the remaining reduction from barren areas.

Table 7.4. Phased Sediment TMDL Load Allocation Scenarios for Phillips Creek

Allocations can be found in the amendment attached to the end of this document: Amendment to the TMDL document, titled *North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments Wise County, Virginia* (Initially submitted to VADEQ April 2010)

The sediment TMDL for the Phillips Creek watershed is 526.4 t/yr, with a modeling target equal to the TMDL minus the MOS (526.4 – 52.6 = 473.8 t/yr), requiring an overall reduction of 9.3% from existing loads. The Phillips Creek sediment TMDL was developed to meet the sediment load of the area-adjusted TMDL reference watershed defined by station 6ADIS017.94 on Dismal Creek. From the three alternative scenarios explored, Alternative 3 is recommended as the starting point for consideration by a local watershed steering committee during the implementation phase.

In the South Fork Pound River, all TMDL alternatives account for upstream allocations for the Phillips Creek TMDL and call for 100% reduction from AML and 0% reduction from permitted sources. TMDL Alternative 1 represents equal % reductions from all other source categories; TMDL Alternative 2 calls for equal % reductions from the three major sources in addition to AML; and TMDL Alternative 3 takes reductions only from the barren category and AML.

Table 7.5. Phased Sediment TMDL Load Allocation Scenarios for South Fork Pound River

Allocations can be found in the amendment attached to the end of this document: Amendment to the TMDL document, titled *North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments Wise County, Virginia* (Initially submitted to VADEQ April 2010)

The sediment TMDL for the South Fork Pound River watershed is 3,621.1 t/yr, with a modeling target equal to the TMDL minus the MOS (3,621.1 - 362.1 = 3,259.0 t/yr), requiring an overall reduction of 58.5% from existing loads. The South Fork Pound River sediment TMDL was developed to meet the sediment load of the area-adjusted TMDL reference watershed defined by station 6ADIS017.94 on Dismal Creek. From the three alternative scenarios explored, Alternative 3 is recommended as the starting point for consideration by a local watershed steering committee during the implementation phase.

In the Lower North Fork Pound River watershed, barren areas along the riparian corridor and outflow from the dam appear to be the primary sources of sediment in the minor impairment of this stream segment. In the Phillips Creek and South Fork Pound River watersheds, AML and barren land uses are the primary sources of sediment. AML reclamation and improved erosion control management and minimization of disturbed area footprints are recommended as the primary targets of implementation efforts. Barren land uses result from construction of access roads and drilling sites for gas and oil wells, logging, and from residential activities. The sediment TMDLs for Lower North Fork Pound River, Phillips Creek, and South Fork Pound River are being developed as phased TMDLs because of uncertainties in contributions of simulated loads from various land uses, including permitted sources. Additional monitoring will be conducted during the 2-year phased TMDL period, including TSS monitoring during storms currently allowed to meet an alternate standard for settleable solids. TMDL modeling will be revised based on the additional monitoring data.

7.1.4. Maximum Daily Load (MDL) for Sediment

The USEPA has mandated that TMDL studies submitted since 2007 include a maximum "daily" load (MDL), in addition to the average annual load shown in the previous section (USEPA, 2006a). The approach used to develop the MDL was provided in Appendix B of a related USEPA guidance document (USEPA, 2006b). The appendix entitled "Approaches for developing a Daily Load Expression for TMDLs computed for Longer Term Averages" is dated December 15, 2006. This guidance provides a procedure for calculating an MDL (t/day) for each watershed from the long-term average annual TMDL load (t/yr) and a coefficient of variation (CV) based on annual loads over a period of time. Annual simulated loads for each of the impaired North Fork and South Fork Pound River watersheds were analyzed over the 13-year simulation period. The Lower North Fork Pound River produced annual sediment loads ranging from 146 to 18,261 t/yr and a CV of 0.932. Phillips Creek produced annual sediment loads ranging from 1,891 to 25,484 t/yr and a CV of 0.738. The South Fork Pound River produced annual sediment loads ranging from 17,216 to 96,127 t/yr and a CV of 0.532. "Long-term average to maximum daily load" multipliers were then interpolated from the USEPA guidance and calculated as 6.143, 4.888, and 3.564 for these three watersheds, respectively. The MDL was calculated as the annual TMDL load (t/yr), divided by 365 days/yr, times the appropriate multiplier. Since the WLA represents permitted loads, no multiplier was applied to these loads. The annual WLA load (t/yr) was converted to a daily load by dividing by 365 days/yr. The daily MOS was calculated in the same manner as the long-term average annual TMDL (10% of the MDL), and daily LA was calculated as the MDL minus the daily WLA minus the daily MOS. The resulting daily MDLs and associated components for the impaired North Fork and South Fork Pound River watersheds are shown in Table 7.6. Expressing the TMDL as a daily load does not interfere with a permit writer's authority under the regulations to translate that daily load into the appropriate permit limitation, which in turn could be expressed as an hourly, weekly, monthly or other measure (USEPA, 2006a).

Table 7.6. Maximum "Daily" Sediment Loads (t/day) for North Fork and South Fork Pound River Watersheds

Allocations can be found in the amendment attached to the end of this document: Amendment to the TMDL document, titled *North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments Wise County, Virginia* (Initially submitted to VADEQ April 2010)

<u>South Fork Pound River Phased TDS TMDLs</u>

7.1.5. Existing Conditions

Table 7.7 shows annual TDS loads (kg/yr) averaged over the 6.08-yr simulation period (January 2000 – January 2006) by source category for existing conditions in both Phillips Creek and South Fork Pound River.

Table 7.7. Sources of Existing TDS Loads (kg/yr)

TDS Sources	Phillips Creek (kg/yr)	SF Pound River* (kg/yr)
Permitted Mining	1,512,101	8,552,267
Pre-law mine discharge	25,371	60,494
AML	26,268	1,021,794
Background	41,791	402,806
Road salt	556	69,751
Residential	224	10,471
Total	**1,606,310**	**10,117,581**
* Includes Phillips Creek		

7.1.6. TDS TMDL Endpoint

The TDS concentration endpoint for TMDLs in both Phillips Creek and the South Fork Pound River was 369 mg/L, the 90th percentile of DEQ-monitored TDS concentrations from Lower Dismal Creek at DEQ monitoring station 6ADIS001.24.

7.1.7. Allocation Scenarios

The TDS concentration endpoints for Phillips Creek and the South Fork Pound River were achieved by making incremental reductions from various anthropogenic sources of TDS and then simulating the corresponding TDS concentrations and loads. Residential sources of TDS and AML sources of TDS were reduced first, as shown in Table 7.8. After that, various percent reductions were applied to active mining sources until the maximum daily average TDS concentration goal of 369 mg/L was achieved in the Phillips Creek watershed. Then, variable reductions were applied to active mining sources and pre-law mine discharges in downstream portions of South Fork Pound River and adjusted in order to minimize the overall load reductions needed. A summary of the percent reductions, the resulting maximum daily average concentration, the corresponding annual TDS load, and the overall percent load reduction for a number of scenarios are shown in Table 7.8. The time-series of TDS concentrations before and after allocation are shown in Figure 7.1 and Figure 7.2 for Phillips Creek and South Fork Pound River, respectively.

Table 7.8. Allocation Reduction Scenarios for Phillips Creek and South Fork Pound River

Allocations can be found in the amendment attached to the end of this document: Amendment to the TMDL document, titled *North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments Wise County, Virginia* (Initially submitted to VADEQ April 2010)

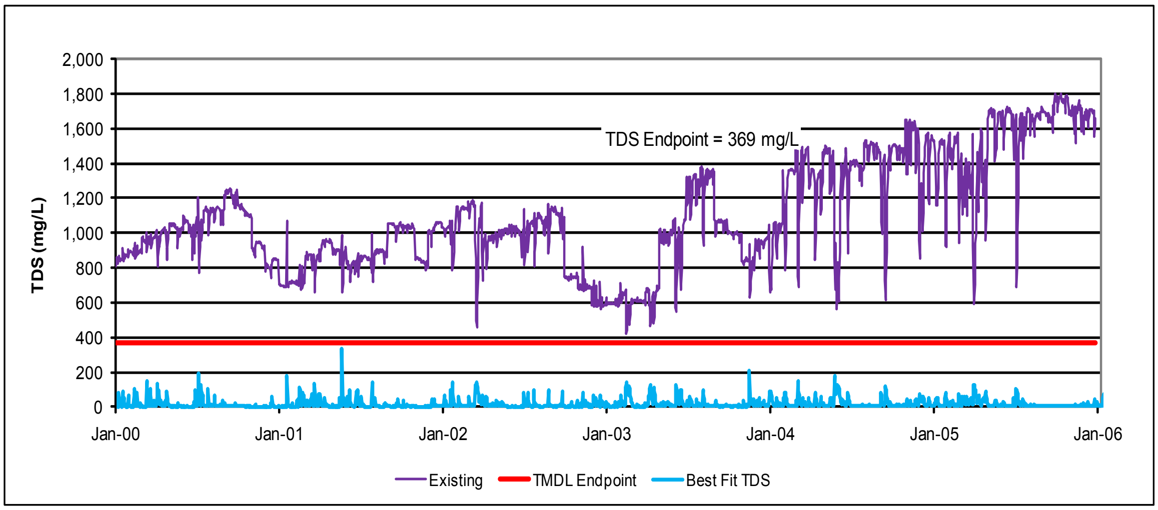

Figure 7.1. Existing and Allocated TDS time-series concentrations in Phillips Creek

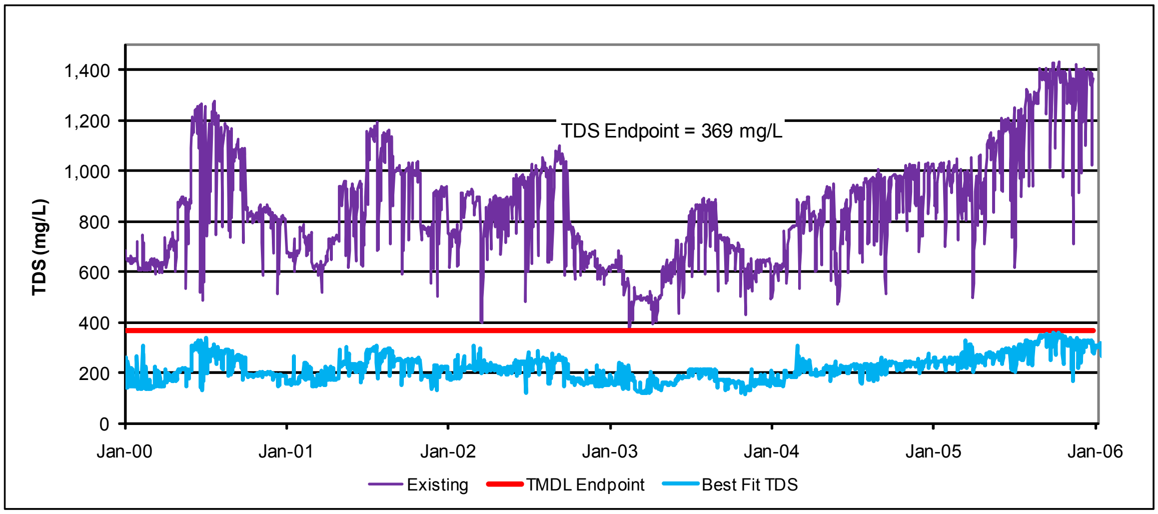

Figure 7.2. Existing and Allocated TDS time-series concentrations in South Fork Pound River

7.1.8. South Fork Pound River Phased TDS TMDLs

The phased TDS TMDLs for the two impaired South Fork Pound River stream segments were calculated using the following equation:

$$TMDL = \sum WLA + \sum LA + MOS$$

where $\sum WLA$ = sum of the waste load (permitted) allocations;

$\sum LA$ = sum of load (nonpoint source) allocations; and

MOS = margin of safety.

The MOS used in this TMDL was implicit, based on the use of the conservative 90th percentile of observed TDS concentrations in the reference watershed for setting the TMDL TDS concentration endpoint. In Lower Dismal Creek, the 90th percentile values were actually 15.5% lower than the maximum observed values. The WLA was calculated as the combined allocated loads from mining sources from a combination of surface runoff, interflow, and groundwater loads, based on reductions in the TMDL allocation scenario (Run 8 in Table 7.8). Individual WLAs for each mining permit were based on the proportionate area of each permit within each of the 19 modeling sub-watersheds multiplied times the TDS load from permitted mining sources in each sub-watershed. The LA component load was calculated as the TDS load from road salts, residential land uses, and allocation scenario groundwater loads from sub-watersheds without mining permits. The overall load reductions required to attain the 369 mg/L TDS endpoint in Phillips Creek and the South Fork Pound River were 95.5% and 71.2%, respectively, as shown in Table 7.8. The TMDL and its component loads for the Phillips Creek and South Fork Pound River TDS TMDLs are shown in Table 7.9 and Table 7.10, respectively.

Table 7.9. Phillips Creek Phased TDS TMDL (kg/yr)

Allocations can be found in the amendment attached to the end of this document: Amendment to the TMDL document, titled *North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments Wise County, Virginia* (Initially submitted to VADEQ April 2010)

Table 7.10. South Fork Pound River Phased TDS TMDL (kg/yr)

Allocations can be found in the amendment attached to the end of this document: Amendment to the TMDL document, titled *North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments Wise County, Virginia* (Initially submitted to VADEQ April 2010)

In these watersheds, after source characterization and modeling were completed, AML areas, pre-law mine discharges, and active mining sources were assessed as the primary contributors of TDS. AML reclamation and improved source reduction and site management of active mining areas are recommended as the primary targets of implementation efforts.

CHAPTER 8: PHASED TMDLS

Guidance on Phased TMDLs

Current EPA guidance recommends that the phased TMDL approach be used in situations “where limited existing data are used to develop a TMDL and the State believes that the use of additional data or data based on better analytical techniques would likely increase the accuracy of the TMDL load calculation and merit development of a second phase TMDL” (USEPA, 2006c). All phased TMDLs must include all elements of a regular TMDL, including load allocations, wasteload allocations and a margin of safety. Each phase must be established to attain and maintain the applicable water quality standard. In addition, EPA recommends that a phased TMDL document include a monitoring plan and a scheduled timeframe for revision of the TMDL in a second phase (EPA, 2006). Because of the uncertainties in representing mining sources in preliminary modeling and the subsequent load allocations, phased TMDLs are being developed for sediment in the Lower North Fork Pound River watershed and for both sediment and TDS in the South Fork Pound River watersheds.

State TMDL Regulatory Agencies

The Virginia Department of Mines, Minerals and Energy (DMME) is the delegated agency to administer the VPDES permit program for regulating stormwater runoff from mining sites.

The Virginia Department of Conservation and Recreation (DCR) is the delegated agency to administer the VPDES permit program for regulating stormwater runoff from urban areas.

The Virginia Department of Environmental Qualilty (DEQ) is authorized by the Code of Virginia to develop YMDLs and plans to implement TMDLs in accordance with the provisions of the Clean Water Act and EPA’s enabling regulation 40 CFR § 130.7.

Also, EPA's 40 CFR § 122.44 (d)(1)(vii)(B) states that VPDES permits must be consistent with new or revised TMDL WLAs.

Rationale for the Use of Phased Sediment TMDLs for North Fork and South Fork Pound River

Modeling of the North Fork and South Fork Pound River watersheds produced monthly flow volumes and total suspended sediment (TSS) loads, with major contributions from abandoned mine land (AML) and active mining sites. This modeling relied on land use-based parameters that governed surface runoff and erodibility, with limited data available in the literature to evaluate and differentiate between active these two major sediment sources. Furthermore, the trapping efficiencies of sediment ponds are highly variable, and sufficient data were not available in the North Fork and South Fork Pound River watersheds to evaluate site specific values, leading to the use of debatable values arrived at through calibration. In addition, the limited TSS data available in North Fork and at the calibration stations in South Fork Pound River had a limited range of rainfall-runoff response, making it difficult to judge the reasonableness of modeled load estimates and of relative loads from various mining sources.

EPA's 40 CFR § 434 contains TSS criteria for storms with provisions for alternative measurements during certain conditions. In a DMLR 1994 Memorandum to Operators, the "settleable solids" parameter was allowed as an alternative to TSS on days with a rainfall total of greater that 0.2 inches/day.

Between the 0.2 in/day storm and the 10-yr 24-hr design storm, settleable solids may be analyzed instead of TSS for mining permit compliance purposes. Since sediment is more likely to be contributed from nonpoint sources during larger rainfall events, this has resulted in fewer TSS measurements from permitted sources against which to evaluate the reasonableness of modeled TSS loads due to surface runoff.

Large TSS loads from AML areas were modeled in the TMDL and represent the largest single source of TSS in the North Fork and South Fork Pound River watersheds. There is a general consensus by the state agencies that an effective way to reduce the majority of excessive TSS loads is through incentives for re-mining and reclaiming these AML areas. As the first phase of the North Fork and South Fork Pound River TMDLs is proposed to last two years, this phased TMDL provides a 2-year window to encourage mine operators to re-mine or reclaim AML and to demonstrate the potential of re-mining, by itself, to meet the major sediment reductions from this source which are called for in this TMDL and to restore the aquatic health of the North Fork and South Fork Pound River.

The North Fork and South Fork Pound River watersheds are also under the Consent Decree schedule for the Commonwealth of Virginia and their TMDLs must be completed by May 2010.

Rationale for the Use of Phased TDS TMDLs for South Fork Pound River watersheds

Although calibration of simulated with in-stream observed TDS concentrations instills confidence in the overall TDS loading in the watershed, the load distribution between permitted mining sources and AML, and between surface, interflow, and groundwater flow paths from each of these sources is highly uncertain. Additional monitoring is needed to determine the most equitable distribution of the required TDS load reductions between pre-existing and currently permitted mining sources.

Components of the North Fork and South Fork Pound River Phased Sediment TMDLs

The North Fork and South Fork Pound River Phased TMDLs for sediment will be developed in accordance with EPA's 2006 Guidance on Phased TMDL and will include the following components:

1. The TSS load from permitted mining areas will be calculated from the maximum daily TSS permit criterion of 70 mg/L and the simulated average annual surface runoff volume from extractive land uses for all storms, and will comprise the permitted mining component of the WLA.
2. Consistent with current permit conditions, no additional reductions will be required from permitted mining sites below a maximum daily TSS

concentration of 70 mg/L, pending further data collection and analysis during the next phase.

3. To address the TSS data deficiency for storm events, monitoring during the 2-yr phased TMDL period will include the full range of storm events occurring below the 10-yr, 24-hr design storm. This will improve the assessment of sediment loads from active mining areas.

DMME's March 30, 2009 Memorandum will assist the phased TMDL monitoring effort, by requiring additional TSS sampling for all National Pollutant Discharge Elimination System (NPDES) discharges in TMDL watersheds where TSS is a stressor and in impaired watersheds where resource extraction is listed as causing the impairment. It is important that TSS monitoring be performed during all storm events, because TSS loads are currently not tracked when alternate effluent limits are utilized.

Components of the South Fork Pound River Phased TDS TMDLs

The South Fork Pound River Phased TMDLs for TDS will be developed in accordance with EPA's 2006 Guidance on Phased TMDL and will include the following components:

1. For the phased TDS TMDL, TDS loads will be calculated for each mining permit based on simulated loads with all TDS sources turned off except those related to permitted mining. The TDS loads from each sub-watershed will then be apportioned on an area-basis to all permits within each sub-watershed. TDS loads attributed to each permit will be summed from all sub-watersheds that included part of each permit's area.

2. Expanded DMLR requirements, as noted in a March 30, 2009 Memorandum to coal mining permittees, will include TDS monitoring at all outfalls in watersheds where an Aquatic Life Use impairment has been identified, in addition to those where TDS has already been identified as a stressor.

3. Although difficult to quantify, additional monitoring is needed to more accurately distinguish between levels of TDS attributable to permitted

mining and AML from surface runoff, interflow and groundwater, as well as relative contributions between surface and deep mining.

4. DMLR’s joint SMCRA/NPDES permits are made consistent with approved coalfield TMDLs. Since 2005, DMLR has utilized electronic permitting processes and specially designed TMDL software to insure consistency.

CHAPTER 9: TMDL IMPLEMENTATION

The goal of the TMDL program is to establish a three-step path that will lead to attainment of water quality standards. The first step in the process is to develop TMDLs that will result in meeting water quality standards. This report represents the culmination of that effort for the benthic impairments on Lower North Fork and South Fork Pound River. The second step is to develop a TMDL implementation plan (IP). The final step is to implement the TMDL implementation plan and to monitor stream water quality to determine if water quality standards are being attained.

Once a TMDL has been approved by USEPA and then the State Water Control Board (SWCB), measures must be taken to reduce pollution levels in the stream. These measures, which can include the use of better treatment technology and the installation of best management practices (BMPs), are implemented in an iterative process that is described along with specific BMPs in the implementation plan. The process for developing an implementation plan has been described in the recent "TMDL Implementation Plan Guidance Manual", published in July 2003 and available upon request from the DEQ and DCR TMDL project staff or at http://www.deq.state.va.us/tmdl/implans/ipguide.pdf. With successful completion of implementation plans, Virginia will be well on the way to restoring impaired waters and enhancing the value of this important resource. Additionally, development of an approved implementation plan will improve a locality's chances for obtaining financial and technical assistance during implementation.

DCR and DEQ will work closely with watershed stakeholders, interested state agencies, and support groups to develop an acceptable implementation plan that will result in meeting the water quality target. Stream delisting of impaired segments of the North and South Forks of the Pound River, including Phillips Creek, will be based on biological health and not on numerical pollution loads. Since this TMDL consists of NPS load allocations originating from old abandoned mines and wasteloads originating from permitted active mines, DMME will share responsibilities with DCR during implementation.

Staged Implementation

Implementation of BMPs in these watersheds will occur in stages. The benefit of staged implementation is that it provides a mechanism for developing public support and for evaluating the efficacy of the TMDL in achieving the water quality standard.

In general, Virginia intends for the required reductions to be implemented in an iterative process that first addresses those sources with the largest impact on water quality. Among the sediment and TDS sources identified in the North Fork and South Fork Pound River watersheds, the following BMPs should be useful in effecting the necessary reductions. Abandoned mine land (AML) areas could be addressed through re-mining, offsets, and through stabilization of critical areas; barren areas through establishment of vegetative cover; residential/urban areas and channel erosion through a combination of streambank stabilization measures and establishment of riparian buffers.

The iterative implementation of BMPs in the watershed has several benefits:

1. It enables tracking of water quality improvements following BMP implementation through follow-up stream monitoring;
2. It provides a measure of quality control, given the uncertainties inherent in computer simulation modeling;
3. It provides a mechanism for developing public support through periodic updates on BMP implementation and water quality improvements;
4. It helps ensure that the most cost effective practices are implemented first; and
5. It allows for the evaluation of the adequacy of the TMDL in achieving water quality standards.

Watershed stakeholders will have opportunity to participate in the development of the TMDL implementation plan. Specific goals for BMP implementation will be established as part of the implementation plan development.

It is recommended that reclamation of AML be one of the initial targets for both sediment and TDS reductions during implementation. Additionally, it is recommended that straight pipes and failing septic systems also be addressed during the initial stages of implementation. It is anticipated that waste load allocations and pollutant load reductions of sediment and TDS to address benthic impairments will be achieved in watersheds with active mining through properly installed and maintained sediment control measures and BMPs (the BMP Approach) instead of altered effluent limitations.

Link to ongoing Restoration Efforts

Implementation of this TMDL will contribute to on-going water quality improvement efforts in the North Fork and South Fork Pound River.

Reasonable Assurance for Implementation

TMDL Compliance Monitoring

DEQ will continue monitoring stations 6APNK000.08, 6APNS000.40, and 6APNS008.73 in accordance with its biological monitoring program, and TDS and TSS at station 6APNK000.08 and 6APNS003.38 in accordance with its ambient monitoring program. DEQ will continue to use data from these monitoring stations and related ambient monitoring stations to evaluate improvements in the benthic community and the effectiveness of TMDL implementation in attainment of the general water quality standard.

DMLR requires all NPDES discharge permittees to monitor total dissolved solids (TDS) in TMDL watersheds where aquatic life use impairments have been identified. Additionally, in a March 30, 2009 Memorandum to all coal mining permittees, DMLR is now requiring permittees to analyze for TSS during qualifying precipitation events, where previously only an alternative parameter – settleable solids – was required. Therefore, TSS data will be available for the full range of precipitation events up through the 10-yr, 24-hr design storm. BMPs specified in NPDES permits are currently required to control runoff from a 10-yr, 24-hr precipitation event (Title 40 §434, Electronic Code of Federal Regulations). The enhanced TMDL stressor monitoring will be in accordance with DMLR's monitoring guidance DMME, 2008.

Since TMDLs are expressed in terms of annual loads, discharge flow rates should be measured concurrently with water quality sampling, and recorded together with daily precipitation data monitored by DMLR-approved sources. When monitoring indicates that the TMDL TDS WLAs are being exceeded DMLR will implement the agency's Waste Load Reduction Actions.

Regulatory Framework

Federal Regulations

While section 303(d) of the Clean Water Act and current USEPA regulations do not require the development of TMDL implementation plans as part of the TMDL process, they do require reasonable assurance that the load and wasteload allocations can and will be implemented. Federal regulations also require that all new or revised National Pollutant Discharge Elimination System (NPDES) permits must be consistent with the assumptions and requirements of any applicable TMDL WLA (40 CFR §122.44 (d)(1)(vii)(B)). All such permits should be submitted to USEPA for review.

State Regulations

Additionally, Virginia's 1997 Water Quality Monitoring, Information and Restoration Act (WQMIRA) directs the State Water Control Board to "develop and implement a plan to achieve fully supporting status for impaired waters" (Section 62.1-44.19.7). WQMIRA also establishes that the implementation plan shall include the date of expected achievement of water quality objectives, measurable goals, corrective actions necessary and the associated costs, benefits and environmental impacts of addressing the impairments. USEPA outlines the minimum elements of an approvable implementation plan in its 1999 "Guidance for Water Quality-Based Decisions: The TMDL Process." The listed elements include implementation actions/management measures, timelines, legal or regulatory controls, time required to attain water quality standards, monitoring plans and milestones for attaining water quality standards.

For the implementation of the WLA component of the TMDL, the Commonwealth utilizes the Virginia NPDES program, which typically includes consideration of the WQMIRA requirements during the permitting process. Requirements of the permit process should not be duplicated in the TMDL process and implementation plan development, especially those implemented through water quality based effluent limitations. However, those requirements that are considered best management practices (BMPs) may be enhanced by inclusion in the TMDL IP, and their connection to the targeted impairment. New permitted point source discharges will be allowed under the waste load allocation provided they implement applicable VPDES and Virginia's Coal Surface Mining Reclamation Regulations (CSMRR) requirements (including any BMP, offset, trading or payment-in-lieu conditions established to meet any future reduction requirements).

Stormwater Permits

The impaired portions of the North Fork and South Fork Pound River watersheds being addressed in this TMDL primarily contain land uses of active mining, abandoned mine lands, forest, and reclaimed lands. USEPA delegated the authority for stormwater management of historic and active mining lands to DEQ through Virginia's NPDES permit program. This program is currently administered through DMME (§45.1-254 of the Code of Virginia). DMME monitoring data and modeling of local daily precipitation and hydrology have shown the major sediment loading sources in these watersheds to be stormwater runoff from AML and barren lands.

Existing Active Mine Drainage Controls

In November 2005, DMME's Division of Mined Land Reclamation (DMLR) issued Guidance Memorandum No. 14-05 to address the implementation of coal mining-related TMDL wasteload allocations. The memorandum can be accessed at http://www.dmme.virginia.gov/DMLR/docs/operatormemos.shtml. As of December 1, 2005 the Division of Mined Land Reclamation (Division) has been implementing the steps outlined in the memorandum regarding permit applications in watersheds with adopted benthic Total Maximum Daily Loads (TMDLs), as described below.

Active mining operations are required to use sediment control measures and BMPs to prevent additional contributions of solids to streams and to minimize erosion to the extent possible by Virginia's Coal Surface Mining Reclamation Regulations (CSMRR; 4 VAC 25-130. The measures include practices carried out within and adjacent to the disturbed mining area and consist of the utilization of proper mining and reclamation methods and control practices, singly or in combination. These methods and practices include, but are not limited to:

1. Disturbing the smallest area at any one time during the mining operation through progressive backfilling, grading, and prompt revegetation;
2. Stabilizing the backfill material to promote a reduction in the rate and volume of runoff;
3. Diverting runoff away from disturbed areas;
4. Directing water and runoff with protected channels;
5. Using straw, mulches, vegetative filters, and other measures to reduce overland flow;
6. Reclaiming all lands disturbed by mining as contemporaneously as practicable.

Additional Active Mine Drainage TMDL Controls

In addition to the use of sediment control measures and BMPs within the disturbed area, CSMRR require coal mining haulroads to be designed and constructed to ensure environmental protection appropriate for their intended use. In a watershed where pollution load reductions for solids are necessary for active mining operations to meet an approved TMDL, haulroad design, construction, and maintenance shall be performed in consideration of the TMDL. This may include, but not be limited to:

1. Using non-toxic-forming substances in road surfacing;
2. Paving haulroads;
3. Increasing the detention capacity of haulroad sumps;
4. Increasing the frequency of inspection and maintenance of haulroad sumps.

Reduction in the sedimentation and mineralization of runoff attendant to mined land erosion and strata exposure may also be achieved with sediment control measures and BMPs. Operation and reclamation plans mandated by CSMRR can be designed and developed to incorporate a BMP approach for meeting waste load allocations and pollutant load reductions included in a TMDL for stream segments and watersheds where sediment and TDS have been identified as the benthic stressors, as outlined by the November 23, 2005 DMME guidance (DMME, 2005).

Significant sediment and TDS loads in the South Fork Pound River watershed arise from AML, and one of the most important existing incentives for addressing this source is the alternative effluent limitations regulations [Section 301(p) in the 1987 Clean Water Act Amendments], also known as the Rahall Amendment. These regulations provide an incentive to mine operators to gradually improve the water quality from these problem areas until reclamation is completed, at which time water quality standards should be met.

Generally, a BMP approach will be used in Virginia to meet WLAs in lieu of alternate effluent limitations for permitted coal mine point source discharges. DMME will track assigned and available WLAs. Prior to approval of new NPDES points within a TMDL watershed, the DMME Division of Water Quality staff will conduct a waste load evaluation to determine whether a WLA is available.

1. Redundant, additional, and/or over-engineered BMPs or practices within permitted mining acreages to better control stormwater transport of pollutants should be implemented.
    a. Enhancement or increasing stream bank buffers in permit acreage or along haul roads should be included;
    b. Streambank stabilization, where possible, in permit acreage or downstream affected areas.
2. Effective windrows (such as those required by Division of Gas and Oil, Department of Mines, Minerals, and Energy) should be installed below drainage paths of existing haul roads.
3. Prompt reclamation or restoration of disturbed lands should be implemented to reduce the generation and transport of sediment and TDS from the disturbed areas.

Implementation Funding Sources

Implementation funding sources will be determined during the implementation planning process by the local watershed stakeholder planning group with assistance from DEQ, DCR, and DMME. Potential sources of funding include Section 319 funding for Virginia's Nonpoint Source Management Program, the U.S. Department of Agriculture's Conservation Reserve Enhancement and Environmental Quality Incentive Programs, the Virginia State Revolving Loan Program, the Virginia Water Quality Improvement Fund, and the Abandoned Mine Lands program, although other sources are also available for specific projects and regions of the state. The TMDL Implementation Plan Guidance Manual contains additional information on funding sources, as well as government agencies that might support implementation efforts and suggestions for integrating TMDL implementation with other watershed planning efforts.

Reasonable Assurance Summary

Watershed stakeholders will have opportunities to provide input and to participate in the development of the implementation plan, which will also be supported by regional and local offices of DEQ, DCR, and other cooperating agencies.

Once developed, DEQ intends to incorporate the TMDL implementation plan into the appropriate Water Quality Management Plan (WQMP), in accordance with the Clean Water Act's Section 303(e). In response to a Memorandum of Understanding (MOU) between USEPA and DEQ, DEQ also submitted a draft Continuous Planning Process to USEPA in which DEQ commits to regularly updating the WQMPs. Thus, the WQMPs will be, among other things, the repository for all TMDLs and TMDL implementation plans developed within a river basin.

Taken together, the follow-up monitoring, WQMIRA, the DMME guidance, the Rahall Amendment, public participation, the Continuing Planning Process, a focus on the legacy of impacts associated with historical coal mining in the South Fork Pound River Watershed through the state's AML Program, and the promotion of re-mining comprise a reasonable assurance that the South Fork Pound River TMDLs will be implemented and water quality will be restored.

PUBLIC PARTICIPATION

Public participation was elicited at every stage of the TMDL development in order to receive inputs from stakeholders and to apprise the stakeholders of the progress made.

The first Technical Advisory Committee and Public Meetings for the North Fork and South Fork Pound River impairments were both held on January 30, 2007 at the Pound Town Hall on 8422 North River Drive in Pound, Virginia. The meetings were preceded by a tour of the watershed led by Roger Jones, an engineer with the Red River Coal Company. These meeting were used to gather information on, and to verify existing data for, the North Fork and South Fork Pound River watersheds. Copies of the presentation materials were available for public distribution at the meeting and at our web site forum, http://www.tmdl.bse.vt.edu/forums/. The TAC meeting was attended by 10 stakeholders, and 17 people attended the public meeting.

A second meeting of the Technical Advisory Committee was held on August 29, 2007 at the Pound Town Hall to discuss the results of the benthic stressor analysis report. The benthic stressor analyses and the proposed reference watersheds were presented at this meeting. Copies of the presentation materials were available for public distribution at the meeting and at our web site forum, http://www.tmdl.bse.vt.edu/forums/. This meeting was attended by 8 stakeholders.

A public meeting to present the draft TMDL report for the North Fork and South Fork Pound River that was been developed for both TDS and sediment to address the benthic impairments was held on March 25, 2008, also at the Pound Town Hall. This public meeting was attended by 11 stakeholders. The public comment period ended on April 24, 2008.

Due to major revisions to the draft TMDLs, another public meeting was held on September 25, 2008 to present the revised draft sediment and TDS TMDLs. This meeting was also held at the Pound Town Hall in Pound, Virginia.

This public meeting was attended by 21 stakeholders. The public comment period ended on October 24, 2008.

Uncertainties related to the modeling and source differentiation led to the development of phased TMDLs which will be presented at a public meeting scheduled for February 2, 2010. Public comment on the phased TMDLs for North Fork and South Fork Pound River may be submitted to DEQ until the end of the 30-day comment period on March 4, 2010.

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Appendix A: Glossary of Terms

Glossary of Terms

Allocation

That portion of a receiving water's loading capacity that is attributed to one of its existing or future pollution sources (nonpoint or point) or to natural background sources.

Allocation Scenario

A proposed series of point and nonpoint source allocations (loadings from different sources), which are being considered to meet a water quality planning goal.

Background levels

Levels representing the chemical, physical, and biological conditions that would result from natural geomorphological processes such as weathering and dissolution.

Best Management Practices (BMP)

Methods, measures, or practices that are determined to be reasonable and cost-effective means for a land owner to meet certain, generally nonpoint source, pollution control needs. BMPs include structural and nonstructural controls and operation and maintenance procedures.

Calibration

The process of adjusting model parameters within physically defensible ranges until the resulting predictions give a best possible good fit to observed data.

Direct nonpoint sources

Sources of pollution that are defined statutorily (by law) as nonpoint sources that are represented in the model as point source loadings due to limitations of the model. Examples include: direct deposits of fecal material to streams from livestock and wildlife.

E-911 digital data

Emergency response database prepared by the county that contains graphical data on road centerlines and buildings. The database contains approximate outlines of buildings, including dwellings and poultry houses.

Hydrology

The study of the distribution, properties, and effects of water on the earth's surface, in the soil and underlying rocks, and in the atmosphere.

Load allocation (LA)

The portion of a receiving water's loading capacity that is attributed either to one of its existing or future nonpoint sources of pollution or to natural background.

Margin of Safety (MOS)

A required component of the TMDL that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving waterbody. The MOS is normally incorporated into the conservative assumptions used to develop TMDLs (generally within the calculations or models). The MOS may also be assigned explicitly, as was done in this study, to ensure that the water quality standard is not violated.

Model

Mathematical representation of hydrologic and water quality processes. Effects of Land use, slope, soil characteristics, and management practices are included.

Nonpoint source

Pollution that is not released through pipes but rather originates from multiple sources over a relatively large area. Nonpoint sources can be divided into source activities related to either land or water use including failing septic tanks, improper animal-keeping practices, forest practices, and urban and rural runoff.

Point source

Pollutant loads discharged at a specific location from pipes, outfalls, and conveyance channels from either municipal wastewater treatment plants or industrial waste treatment facilities. Point sources can also include pollutant loads contributed by tributaries to the main receiving water stream or river.

Pollution

Generally, the presence of matter or energy whose nature, location, or quantity produces undesired environmental effects. Under the Clean Water Act for example, the term is defined as the man-made or man-induced alteration of the physical, biological, chemical, and radiological integrity of water.

Reach

Segment of a stream or river.

Runoff

That part of rainfall or snowmelt that runs off the land into streams or other surface water. It can carry pollutants from the air and land into receiving waters.

Simulation

The use of mathematical models to approximate the observed behavior of a natural water system in response to a specific known set of input and forcing conditions. Models that have been validated, or verified, are then used to predict the response of a natural water system to changes in the input or forcing conditions.

Total Maximum Daily Load (TMDL)

The sum of the individual wasteload allocations (WLA's) for point sources, load allocations (LA's) for nonpoint sources and natural background, plus a margin of safety (MOS). TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures that relate to a state's water quality standard.

Urban Runoff

Surface runoff originating from an urban drainage area including streets, parking lots, and rooftops.

Validation (of a model)

Process of determining how well the mathematical model's computer representation describes the actual behavior of the physical process under investigation.

Wasteload allocation (WLA)

The portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality-based effluent limitation.

Water quality standard

Law or regulation that consists of the beneficial designated use or uses of a water body, the numeric and narrative water quality criteria that are necessary to protect the use or uses of that particular water body, and an anti-degradation statement.

Watershed

A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

For more definitions, see the Virginia Cooperative Extension publications available online:

Glossary of Water-Related Terms. Publication 442-758.
http://www.ext.vt.edu/pubs/bse/442-758/442-758.html

and

TMDLs (Total Maximum Daily Loads) - Terms and Definitions. Publication 442-550.
http://www.ext.vt.edu/pubs/bse/442-550/442-550.html

Appendix B: Weather Data Preparation

Weather Data Preparation

Introduction

A weather data file for providing the weather data inputs into the HSPF Model was created for the period January 1989 through August 2006 using the Watershed Data Management Utility (WDMUtil). Raw data required for creating the weather data file included precipitation (in.), average daily temperatures (maximum, minimum, and dew point) (°F), average daily wind speed (mi/hr), total daily solar radiation (Langleys), and percent sun. The primary data source was the National Climatic Data Center's (NCDC) Cooperative Weather Station in Wise County, Virginia, which was located about 6 miles southeast of the Pound watershed (Wise 3E, 449215). Data from three other NCDC stations were also used. The raw data required varying amounts of preprocessing within WDMUtil to obtain the following hourly values: precipitation (PREC) (in), air temperature (ATEM) (°F), dew point temperature (DEWP) (°F), solar radiation (SOLR) (Langleys), wind speed (WIND) (mi/hr), potential evapo-transpiration (PEVT) (in), potential evaporation (EVAP) (in), and cloud cover (CLOU) (tenths, range 0-10). The final WDM file contains these hourly datasets.

Raw data collection and processing

Weather data were obtained from the NCDC's weather stations in Wise, VA (449215, Lat./Long. 37°00'N / 82°32'W, elevation 2549 ft); Lonesome Pine Airport, VA (63802 Lat./Long. 36°59'N / 82°32'W, elevation 2684 ft); North Fork Lake, VA (446173, Lat./Long. 37°07'N / 82°38'W, elevation 1675 ft), Bristol Tri City Airport, VA (401094, Lat./Long. 36°28'N / 82°24'W, elevation 1500 ft), Abingdon, VA (440021, Lat./Long. 36°40'N / 81°58'W, elevation 1920 ft) and Lynchburg Airport, VA (445120, Lat./Long. 37°20'N/79°12'W, elevation 286.5 ft). While deciding on the period of record for the weather WDM file, availability of flow and water quality data was considered in addition to the availability and quality of weather data. Data collection for many of the parameters did not begin until 1989, which set the starting point of the period of record. Percent sun data were available only through July 1996. The water quality data were collected from July 1996-August 2006; stream flow data used in calibration were collected from 1963-present. In order to make the best use of the available flow and water quality data, the period of record was chosen to be 1989-2006. Substitutions for missing data are described below. The procedures used to process the raw data to obtain finished data required for input to HSPF are also described in the following sections.

1. Hourly Precipitation
   Hourly precipitation (HPCP) data were downloaded from NCDC's web site for Wise 3E for the entire 1989-2006 period. Over 10% of the hourly values were missing from the station. No other nearby station recorded hourly precipitation data. Therefore, to avoid problems inherent in patching over 10% of the data, the daily record from the Wise 3E station was used instead. Of the 6574 days within the 1989-2006 period of interest, only 31 values were missing (0.5%), and the missing values all occurred in 2003-2006. The missing daily values were patched with data

from the nearby North Fork Lake station. Once the record was patched, WDMUtil's disaggregate precipitation function was used to create an hourly precipitation record. The resulting file was given the constituent label "PREC."

2. Temperature
Separate daily maximum temperature (TMAX) and daily minimum temperature (TMIN) files were downloaded from the NCDC website for the Wise 3E station. The TMAX dataset was missing 42 days of data; the TMIN dataset was missing 47 days of data. Data from the North Fork Lake and Abingdon stations were used to fill in the missing days. Daily dew point temperature (DPTP) was taken predominately from the Lonesome Pine Airport station, the closest station that recorded dew point temperature. These data had units of tenths of degrees Fahrenheit and were divided by a factor of 10 prior to use in the WDM file. The *disaggregate temperature* function in WDMUtil was used to create an hourly average temperature file (ATEM). The *disaggregate dewpoint temperature* function in WDMUtil was used to create an hourly dewpoint temperature file (DEWP).

3. Average Daily Wind Speed
Average daily wind speed (AWND) was not recorded at the Wise 3E station; therefore, average daily wind speed was obtained from the Bristol Tri City Airport. The units of the data were tenths of miles per hour; therefore, the timseries was divided by a factor of 10 prior to use in the WDM file. The *compute wind travel* function in WDMUtil was used to calculate the total wind travel in miles/day. Then the *disaggregate wind travel* function in WDMUtil was used to calculate the hourly wind speed throughout the day (WIND) using the distribution coefficients shown in Table B. 1.

Table B. 1. Hourly Distribution Coefficients for Wind Speed.

Hour	12	1	2	3	4	5	6	7	8	9	10	11
AM	0.035	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.035	0.037	0.041	0.046
PM	0.05	0.053	0.054	0.058	0.057	0.056	0.05	0.043	0.04	0.038	0.036	0.036

4. Cloud cover and solar radiation
In the absence of daily cloud cover, percent sun (PSUN) can be used to estimate DCLO. DCLO is used by WDMUtil to estimate hourly cloud cover in tenths (CLOU) as well as solar radiation (SOLR) in Langleys. The closest weather station that recorded PSUN was Lynchburg Airport, and these data were used to develop the weather file. As previously mentioned, PSUN was only available at this station for the period January 1984-July 1996. It is the experience of the authors that the model is rather insensitive to the parameters derived from PSUN; therefore, to bridge the

gap of missing data, values from August 1996-August 2006 were filled in by copying earlier values from corresponding months.

The *compute percent cloud cover* function in WDMUtil was used to calculate the daily percent cloud cover in tenths (DCLO) from PSUN. Because there is not a *disaggregate percent cloud cover* function available, the *disaggregate wind travel* function was used with hourly distribution coefficients all set to 0.042 to calculate the hourly percent cloud cover in tenths (CLOU).

The *compute solar radiation* function in WDMUtil was used to calculate the daily solar radiation in Langleys (DSOL) from DCLO and the Wise 3E station latitude (37°00'N). The *disaggregate solar radiation* function was then used to calculate the hourly solar radiation (SOLR).

5. Evaporation/Evapotranspiration
   Two types of evaporation/evapotranspiration are required for input to HSPF: potential evaporation from a reach or reservoir surface (EVAP), represented as Penman pan evaporation; and potential evapotranspiration (PEVT), represented as Hamon potential evapotranspiration.

   The *compute Penman pan evaporation* function in WDMUtil was used to calculate daily Penman pan evaporation (DEVP) from TMIN, TMAX, DPTP, TWND, and DSOL. Then the *disaggregate evapotranspiration* function was used to calculate EVAP from DEVP.

   The *compute Hamon PET* function in WDMUtil was used to calculate daily potential evapotranspiration (DEVT) from TMIN, TMAX, the Wise 3E station latitude (37°00'N), and monthly coefficients all equal to 0.005. Then the *disaggregate evapotranspiration* function was used to calculate PEVT from DEVT.

Summary of weather data preparation

The weather data were prepared for input to HSPF as described in the previous section. A summary of the NCDC input parameters, WDMUtil functions used, and final HSPF parameters is presented in Table B. 2.

Table B. 2. Weather parameters and processing in WDMUtil required for HSPF modeling.

NCDC Input Parameters	Intermediate Input	WDMUtil Functions	Intermediate Output	Final HSPF Parameter
PRCP	--	Disaggregate precipitation	--	PREC
TMAX, TMIN	--	Disaggregate temperature	--	ATEM
DPTP	--	Disaggregate dewpoint temperature	--	DEWP
PSUN	--	Compute percent cloud cover	DCLO	--
	DCLO	Disaggregate wind travel[1]	--	CLOU
	DCLO	Compute solar radiation	DSOL	--
	DSOL	Disaggregate solar radiation	--	SOLR
AWND	--	Compute wind travel	TWND	--
	TWND	Disaggregate wind travel	--	WIND
TMAX, TMIN, DPTP	TWND, DSOL	Compute Penman pan evaporation	DEVP	--
	DEVP	Disaggregate evapo-transpiration	--	EVAP
TMAX, TMIN	--	Compute Hamon PET	DEVT	--
	DEVT	Disaggregate evapo-transpiration	--	PEVT

[1]all hourly coefficients set to 0.42

Appendix C: HSPF Parameters that Vary by Month or Land Use

Table C. 1. PWAT-PARM2 parameters varying by land use for North and South Fork Pound River.

	LZSN (in)	INFILT (in/hr)	LSUR (ft)	SLSUR (ft/ft)	KVARY (1/in)	AGWRC (1/day)
Low Intensity Res.	4	0.186	100	0.376	0	0.965
Med. Intensity Res.	4	0.186	200	0.163	0	0.965
High Intensity Res.	4	0.186	100	0.328	0	0.965
Extractive	4	0.186	100	0.408	0	0.965
Barren	4	0.186	100	0.445	0	0.965
Pasture/Hay	4	0.252	150	0.415	0	0.965
Croplands	4	0.286	200	0.206	0	0.965
Forest	4	0.284	50	0.496	0	0.99
AML	4	0.186	50	0.487	0	0.965
Reclaimed	4	0.186	30	0.540	0	0.965
Released	4	0.186	30	0.476	0	0.965
Subwatershed 17		2.0*				

*stream for subwatershed 17 no longer above ground

Table C. 2. PWAT-PARM4 parameters varying by land use for North and South Fork Pound River.

	CEPSC (in)	UZSN (in)	NSUR	INTFW	IRC (1/day)	LZETP
Low Intensity Res.	0.13	0.8	0.1	1.5	0.5	0.7
Med Intensity Res.	0.25	0.8	0.07	1.5	0.5	0.6
High Intensity Res.	0.05	0.8	0.05	1.5	0.5	0.5
Extractive	0.05	0.8	0.011	1.5	0.5	0.4
Barren	0.05	0.8	0.05	1.5	0.5	0.4
Pasture/Hay	0.13	0.8	0.37	1.5	0.5	0.7
Croplands	0.25	0.8	0.27	1.5	0.5	0.6
Forest	0.05	0.8	0.6	1.5	0.5	0.5
AML	0.05	0.8	0.011	1.5	0.5	0.4
Reclaimed	0.05	0.8	0.011	1.5	0.5	0.4
Released	0.05	0.8	0.011	1.5	0.5	0.4
Subwatershed 17				0.5		

Table C. 3. PWAT-STATE1 parameters varying by land use for North and South Fork Pound River.

	UZS	IFWS	LZS	AGWS
Low Intensity Res.	0.499	0	5.714	0.358
Med Intensity Res.	0.505	0	5.245	0.406
High Intensity Res.	0.472	0	5.488	0.411
Extractive	0.674	0.001	5.917	0.362
Barren	0.683	0.003	6.786	0.444
Pasture/Hay	0.499	0	5.714	0.358

Croplands	0.505	0	5.245	0.406
Forest	0.472	0	5.488	0.411
AML	0.656	0.001	6.159	0.388
Reclaimed	0.674	0.001	5.917	0.362
Released	0.683	0.003	6.786	0.444

Table C. 4. MON-INTERCEP (monthly CEPSC) - Monthly Interception Storage.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
L/M/H Residential	0.09	0.09	0.09	0.09	0.09	0.11	0.11	0.11	0.09	0.09	0.09	0.09
Extractive	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.02	0.02
Barren	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.02	0.02
Pasture	0.08	0.09	0.13	0.16	0.18	0.2	0.2	0.2	0.19	0.14	0.1	0.08
Crop	0.06	0.07	0.1	0.18	0.21	0.26	0.26	0.23	0.2	0.18	0.08	0.06
Forest	0.1	0.1	0.13	0.16	0.2	0.32	0.32	0.32	0.2	0.14	0.12	0.1
AML	0.09	0.09	0.09	0.09	0.09	0.11	0.11	0.11	0.09	0.09	0.09	0.09

Table C. 5. MON-LZETP - Monthly Lower Zone Evapo-transpiration Parameter.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
LDR	0.25	0.25	0.3	0.3	0.35	0.35	0.35	0.3	0.3	0.3	0.25	0.25
MDR	0.25	0.25	0.28	0.28	0.33	0.33	0.33	0.3	0.28	0.28	0.25	0.25
HDR	0.25	0.25	0.27	0.27	0.3	0.3	0.3	0.3	0.27	0.27	0.25	0.25
Extractive	0.1	0.1	0.1	0.1	0.15	0.15	0.2	0.2	0.2	0.15	0.1	0.1
Barren	0.1	0.1	0.1	0.1	0.15	0.15	0.2	0.2	0.2	0.15	0.1	0.1
Pasture	0.25	0.35	0.45	0.5	0.55	0.75	0.75	0.65	0.6	0.5	0.4	0.25
Croplands	0.25	0.35	0.45	0.5	0.55	0.75	0.75	0.65	0.6	0.5	0.4	0.25
Forest	0.35	0.35	0.45	0.5	0.55	0.75	0.75	0.65	0.6	0.5	0.45	0.35
AML	0.25	0.25	0.27	0.27	0.3	0.3	0.3	0.3	0.27	0.27	0.25	0.25

Table C. 6. QUAL-INPUT –TDS input parameters for North and South Fork Pound River.

	ACQOP lb/ac.day	SQOLIM lb/ac	WSQOP in/hr	AOQC lb/ft3
Low Intensity Res.				0.01436
Med Intensity Res.				0.01436
High Intensity Res.				0.01436
Extractive	200	400	2.0	0.04683
Barren				0.01436
Pasture/Hay				0.01436
Croplands				0.01436
Forest				0.01873
AML	200	400	2.0	0.04683
Reclaimed	200	400	2.0	0.02342
Released				0.01436

Appendix D: Existing Mining Permits Distributed by Land Use and Sub-watershed

Table D. 1. DMLR Mining Permit Areas within Each South Fork Pound River Sub-watershed.

DMLR Mining Permit Numbers	South Fork Pound River Sub-watersheds (area in acres)														Permit Area in SF Pound R
	2	3	5	6	7	8	12	13	14	15	16	17	18	19	
1100033										0.25	5.31		78.70		**84.26**
1100044								1.30	0.05	0.77					**2.12**
1100520										0.40	193.84		142.64	5.24	**342.13**
1100717					103.59	84.49	53.60	163.41							**405.09**
1100787										33.83	181.20		182.77	40.11	**437.91**
1101102									46.32						**46.32**
1101270	41.11	8.74													**49.85**
1101272										3.47	108.58	558.54	22.99		**693.59**
1101401								253.87	119.09	412.57	7.28				**792.81**
1101565												16.59	8.99	83.53	**109.11**
1101760													21.70	121.50	**143.20**
1201187										1.29	14.41				**15.70**
1201338									31.24						**31.24**
1201664														0.87	**0.87**
1501778														1.61	**1.61**
1600876											0.55	8.73	313.71	163.25	**486.24**
1601939			33.82	6.81											**40.64**
Permit Area by Sub-watershed	**41.11**	**8.74**	**33.82**	**6.81**	**103.59**	**84.49**	**53.60**	**418.59**	**196.69**	**452.60**	**511.18**	**583.86**	**771.50**	**416.12**	**3682.70**

Table D. 2. DMLR Mining Permit Areas Distributed by Land Use within Each South Fork Pound River Sub-watershed.

DMLR Mining Permit No.	Sub-watershed	Total Area (acres) (acres)	Distributed Land Use Areas (acres) Extractive (acres)	Pasture (acres)	Forest (acres)	AML (acres)	reclaimed (acres)	released (acres)
1101270	SFP2	41.11	8.14					32.97
1101270	SFP3	8.74	0.00					8.74
1601939	SFP5	33.82	24.31				9.51	0.00
1601939	SFP6	6.81	3.28				3.53	0.00
1100717	SFP7	103.59	42.39				30.76	30.44
1100717	SFP8	84.49	6.80			12.46	20.15	45.07
1100717	SFP12	53.60	4.03			1.10	14.98	33.50
1100044	SFP13	1.30	0.19			0.01	0.33	0.77
1100717	SFP13	163.41	23.37			1.45	41.98	96.62
1101401	SFP13	253.87	36.30			2.25	65.22	150.10
1100044	SFP14	0.05	0.01				0.01	0.03
1101102	SFP14	46.32	6.22			3.36	6.88	29.86
1101401	SFP14	119.09	15.99			8.65	17.69	76.76
1201338	SFP14	31.42	4.22			2.28	4.67	20.25
1100033	SFP15	0.25	0.02			0.13	0.03	0.07
1100044	SFP15	0.77	0.07			0.40	0.10	0.20
1100520	SFP15	0.40	0.04			0.21	0.05	0.10
1100787	SFP15	33.83	3.01			17.42	4.57	8.83
1101272	SFP15	3.47	0.31			1.79	0.47	0.91
1101401	SFP15	412.57	36.70			212.49	55.70	107.68
1201187	SFP15	1.29	0.11			0.66	0.17	0.34
1100033	SFP16	5.31	0.28			2.19	1.86	0.99
1100520	SFP16	193.84	10.29	4.65	15.04	60.10	67.77	35.99
1100787	SFP16	181.20	9.62			74.59	63.35	33.64
1101272	SFP16	108.58	5.77			44.70	37.96	20.16
1101401	SFP16	7.28	0.39			3.00	2.55	1.35
1201187	SFP16	14.41	0.77			5.93	5.04	2.68
1600876	SFP16	0.55	0.03			0.23	0.19	0.10
1101272	SFP17	558.54	33.65		3.81	215.97	125.02	180.08
1101565	SFP17	16.59	1.00			6.53	3.71	5.35
1600876	SFP17	8.73	0.53			3.44	1.95	2.81
1100033	SFP18	78.70	12.85			11.40	35.53	18.92
1100520	SFP18	142.64	23.29	2.78	8.34	9.54	64.39	34.29
1100787	SFP18	182.77	29.85	2.78	8.34	15.35	82.50	43.94
1101272	SFP18	22.99	3.75			3.33	10.38	5.53
1101565	SFP18	8.99	1.47			1.30	4.06	2.16
1101760	SFP18	21.70	3.54			3.14	9.80	5.22
1600876	SFP18	313.71	51.23			45.45	141.61	75.42
1100520	SFP19	5.24	1.35		0.99		2.11	0.79
1100787	SFP19	40.11	10.36		7.58		16.14	6.03
1101565	SFP19	83.53	21.57	6.55	9.23		33.61	12.57
1101760	SFP19	121.50	31.37	6.55	16.40		48.89	18.28
1201664	SFP19	0.87	0.22		0.16		0.35	0.13
1501778	SFP19	1.61	0.42		0.30		0.65	0.24
1600876	SFP19	163.25	42.15	6.55	24.29		65.70	24.56

TMDL AMENDMENT DATED APRIL 12, 2011

Amendment to the TMDL document, titled *North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments Wise County, Virginia* (Initially submitted to VADEQ April 2010)

1. INTRODUCTION

In addressing provisions of the Clean Water Act and agreements with the United States Environmental Protection Agency, Virginia's Department of Environmental Quality initiated the TMDL development process for North Fork and South Fork Pound Rivers and selected tributaries in Wise County, Virginia. During development of the TMDL, uncertainties and differences of interpretation regarding predictive tools, monitoring data, and field conditions used to allocate pollution loads were identified. Although the TMDL has been submitted as a final draft based on the available data, additional monitoring will be needed and a second phase of development will be necessary. Therefore, the report is being presented as a "phased" TMDL in accordance with EPA guidance.

This is an amendment to the draft phased TMDL report. The pollutant loads have been calculated as described in Section 2 of this document, and the tables presented here supersede those that are in the draft report. New or modified discharge permits for coal mining operations in the watershed will be issued consistent with the WLAs presented in this amendment..

2. ALLOCATION

Details of changes made to the pollutant loads developed for the report titled, *North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments Wise County, Virginia,* are provided here by pollutant. Given the two-year time frame for revising the TMDL, no allocation for "future growth" was included.

2.1 Total Suspended Solids (TSS)

Total Suspended Solids (TSS) was identified as a probable stressor in each of the impaired water bodies addressed by this TMDL (Lower North Fork Pound River, Phillips Creek, and South Fork Pound River). For TSS, the only changes to the TMDL were made to the WLAs.

The WLAs for mining were derived in the following manner; NPDES bimonthly monitoring data in the watershed was selected for each year from 1995 to 2009 for each constructed discharge location. The data utilized consisted of sample date, flow, and concentration for TSS. Each sample record was weighted for the number of days the sample represents and multiplied by the flow and concentration to get the loading in kilograms for that particular sample. Then each record was summed for the year to get an annual waste load. The median of the annual waste loads was then assigned as the mining WLA for the watershed. The median was selected because the data set did not have a normal distribution. The median value is less than the WLA calculated in the draft TMDL, but accurately reflects the current condition in the watershed. Additionally, use of the median is protective of the watershed, as compared to using either the mean or maximum of the data set.

A load for gas and oil permitted discharges was included in the draft TMDL, however there are no discharge permits currently issued for any gas and oil facilities. While gas and oil permits are issued for construction of gas and oil well pumping facilities, these are not discharge permits. . Contributions from gas and oil operations in the watershed are transient, and regulations require that any disturbed acreage during construction and drilling must be stabilized within 30 days. Any contributions from these areas are included in the Load Allocation (LA) of the TMDL.

The single family home discharges (VAG400005, VAG400274, and VAG400556) were included at the same load determined in the draft TMDL, based on a 1,000 gal/day discharge with a maximum 30 mg/l concentration of TSS. The LA and TMDL were not adjusted. The MOS was adjusted to maintain the original TMDL. The MOS is roughly 10% of the TMDL value.

Table 1 shows the average annual TMDL, which gives the average load of TSS that can be present in the stream in a given year, and still protect aquatic life. Starting in 2007, the USEPA has mandated that TMDL studies include a maximum daily load as well as the average annual load previously shown. The approach to developing a daily maximum load was described in Section 7.1.3 of the original TMDL. To be consistent with the original

TMDL development, the WLAs were calculated by dividing the annual WLA by 365 days/year. The maximum daily in-stream loads for the study area are shown in Table 2.

Table 1. Average Annual TMDL TSS allocation (t/yr) in the North Fork and South Fork Pound River watersheds.

Impairment	WLA		LA	MOS	TMDL
Lower North Fork Pound River	0.00		320.00	39.90	359.90
Phillips Creek	8.62		409.00	108.78	526.40
	Permit No.	*WLA*			
	1100033	*0.30*			
	1100520	*1.07*			
	1100787	*1.56*			
	1101272	*3.05*			
	1101565	*0.39*			
	1101760	*0.51*			
	1201664	*0.00*			
	1501778	*0.01*			
	1600876	*1.73*			
South Fork Pound River	15.00		3,012.90	593.20	3,621.10
	Permit No.	*WLA*			
	1100033	*0.30*			
	1100044	*0.01*			
	1100520	*1.22*			
	1100717	*1.44*			
	1100787	*1.56*			
	1101102	*0.17*			
	1101270	*0.18*			
	1101272	*4.23*			
	1101401	*2.82*			
	1101565	*0.39*			
	1101760	*0.51*			
	1201187	*0.06*			
	1201338	*0.11*			
	1201664	*0.00*			
	1501778	*0.01*			
	1600876	*1.73*			
	1601939	*0.14*			
	VAG400005	*0.04*			
	VAG400274	*0.04*			
	VAG400556	*0.04*			

Table 2. Maximum "daily" TSS loads (t/day) in the North Fork and South Fork Pound River watersheds.

Impairment	WLA		LA	MOS	TMDL
Lower North Fork Pound River	0.00		5.44	0.62	6.06
Phillips Creek	0.02		6.17	0.86	7.05
	Permit No.	*WLA*			
	1100033	*0.0008*			
	1100520	*0.0029*			
	1100787	*0.0043*			
	1101272	*0.0083*			
	1101565	*0.0011*			
	1101760	*0.0014*			
	1201664	*0.0000*			
	1501778	*0.0000*			
	1600876	*0.0047*			
South Fork Pound River	0.04		31.15	4.17	35.36
	Permit No.	*WLA*			
	1100033	*0.0008*			
	1100044	*0.0000*			
	1100520	*0.0033*			
	1100717	*0.0039*			
	1100787	*0.0043*			
	1101102	*0.0005*			
	1101270	*0.0005*			
	1101272	*0.0116*			
	1101401	*0.0077*			
	1101565	*0.0011*			
	1101760	*0.0014*			
	1201187	*0.0002*			
	1201338	*0.0003*			
	1201664	*0.0000*			
	1501778	*0.0000*			
	1600876	*0.0047*			
	1601939	*0.0004*			
	VAG400005	*0.0001*			
	VAG400274	*0.0001*			
	VAG400556	*0.0001*			

2.2 Total Dissolved Solids (TDS)

Total Dissolved Solids (TDS) was identified as a probable stressor in two of the impaired water bodies addressed by this TMDL (Phillips Creek, and South Fork Pound River). The TDS loads were calculated using the in-stream water quality endpoint determined in the original TMDL report (369 mg/l) in combination with the average annual flows from the watershed and the permitted discharges. The Department of Mines, Minerals and Energy (DMME) provided the average annual flows from the permitted discharges and overall watershed. The flow data used are appropriate because they represented the best available information collected directly from the impaired watershed. There is no continuous gauging station in the stream. Bimonthly monitoring data collected between 1995 and 2009 was used for the flow calculations. Data was summarized for each constructed discharge location, and representative stream flow locations in the watershed. The data utilized consisted of sample date and flow. Average annual flow volumes were calculated based on the monitored flow values and the time frame represented by the sample. These data provided the best available measure of annual flow, representing varied hydrologic conditions within years (seasonal) and among years (longer-term cycles).

The TMDL is the average load delivered at the outlet of the watershed if the TDS concentration is held constant at 369 mg/l. Similarly, the WLA is the average load delivered from permitted discharges at the same concentration level (369 mg/l). The LA was then calculated as the difference between the TMDL and the WLA. Because this water quality endpoint (369 mg/l) was calculated as the 90th percentile of 34 DEQ-monitored TDS samples taken at station 6ADIS001.24, which has an unimpaired benthic community, it incorporates an implicit margin of safety into the TMDL calculation.

As noted above, a TDS end point concentration of 369 mg/l, based on reference stream measurements, and approximately 15 years of instream data from the impaired creek, covering the full range of precipitation events for that period, was utilized. This approach accounts for background pollutants, critical conditions and seasonal conditions because it makes use of monitored flow data, representing flow contributions from the entire watershed, collected over multiple years. The TMDL, based on the desired water quality endpoint (369 mg/l), is composed of loads from background sources, as well as permitted and non-permitted anthropogenic sources. Critical and seasonal conditions are accounted for, because the flow data were collected over multiple years, including all seasons and various flow regimes.

Table 3 shows the average annual TMDL, which gives the average load of TDS that can be present in the stream in a given year, and still protect aquatic life. Starting in 2007, the USEPA has mandated that TMDL studies include a daily load as well as the average annual load previously shown. The approach to developing a daily maximum load was described in Section 7.1.3 of the original TMDL. A coefficient of variation (COV) of 0.6 was assumed for TDS. To be consistent with the original TMDL development, the WLAs were calculated by dividing the annual WLA by 365 days/year. The maximum daily in-stream loads for the study area are shown in Table 4.

Table 3. Average Annual TMDL TDS allocation (kg/yr) in the North Fork and South Fork Pound River watersheds.

Impairment	WLA		LA	MOS	TMDL
Phillips Creek	75,818		129,712	Implicit	205,530
	Permit No.	*WLA*			
	1100033	*6,557*			
	1100520	*12,031*			
	1100787	*16,339*			
	1101272	*1,916*			
	1101565	*3,065*			
	1101760	*5,178*			
	1201664	*23*			
	1501778	*43*			
	1600876	*30,666*			
South Fork Pound River	1,854,300		3,172,415	Implicit	5,026,715
	Permit No.	*WLA*			
	1100033	*10,761*			
	1100044	*1,213*			
	1100520	*203,606*			
	1100717	*384,095*			
	1100787	*224,403*			
	1101102	*33,593*			
	1101270	*32,771*			
	1101272	*177,579*			
	1101401	*558,431*			
	1101565	*4,360*			
	1101760	*4,134*			
	1201187	*15,556*			
	1201338	*22,656*			
	1201664	*19*			
	1501778	*35*			
	1600876	*26,046*			
	1601939	*155,042*			

Table 4. Maximum "daily" TDS loads (kg/day) in the North Fork and South Fork Pound River watersheds.

Impairment	WLA		LA	MOS	TMDL
Phillips Creek	207		2,045	Implicit	2,252
	Permit No.	*WLA*			
	1100033	*18*			
	1100520	*33*			
	1100787	*45*			
	1101272	*5*			
	1101565	*8*			
	1101760	*14*			
	1201664	*0*			
	1501778	*0*			
	1600876	*84*			
South Fork Pound River	5,080		50,007	Implicit	55,087
	Permit No.	*WLA*			
	1100033	*29*			
	1100044	*3*			
	1100520	*558*			
	1100717	*1,052*			
	1100787	*615*			
	1101102	*92*			
	1101270	*90*			
	1101272	*487*			
	1101401	*1,530*			
	1101565	*12*			
	1101760	*11*			
	1201187	*43*			
	1201338	*62*			
	1201664	*0*			
	1501778	*0*			
	1600876	*71*			
	1601939	*425*			

PUBLIC COMMENTS RECEIVED

Comments on the North Fork and South Fork Pound River Phased TMDLs for Benthic Impairments Wise County, Virginia 2/28/2011 version

Jessica Bier 276-796-5979 9707 Greywell Road Pound VA 24279

I was unaware of the last public meeting on March 8 2011. I think given the relatively low # of stakeholders at the previous public meetings(10 2007, 8 2007, 11 2008, 21 2008), DEQ should do all it can to increase public participation. I am surprised it was not announced in the local paper and I did not receive a notice (I signed up at a previous public meeting). As a concerned citizen and a property owner in the South Fork watershed, I would like to be notified of future meetings and/or comment periods.

COMMENT 1 I do not think the DMME should be the lead agency on development of TMDLs.

The whole TMDL process seems to have been dragged out. The first public meeting was in January 2007. It is now 4 years and 3 months later and we are still waiting approval of a phased TMDL which means that there probably won't be any changes in regulations or enforcement for many years down the road. I cannot help but think that part of the reason for this delay is due to mining interests. I anticipate further delay given that a lead agency for the TMDL development is the DMME.

One of the reasons given for the need for a phased TMDL is lack of data. Shouldn't there have been a lot of data available in this watershed given the amount of mining taking place since all mining permits require repeated ground and surface water testing? If data is lacking and/or questionable, based on my experience, I think some of the fault lies with the DMMEs lack of enforcement. I would like to share my personal experience of this.

About 6 years ago, I requested water monitoring data for a mining permit behind my house. There were huge holes/errors in the data. The Probable Hydrologic Consequences Determination report identified the following monitoring points: 3 piezometers, two springs, and an underdrain. According to the report, in the 14 years since mining operations ceased, 1 sample was collected at one piezometer, 2 samples were collected at a second, and no samples were collected at the third. The conclusion reached in the report was "The review of this information indicates no adverse groundwater conditions exist at these groundwater monitoring points. These sites have been monitored for 14 years after completion materials were approved and are no longer necessary. A request to cease/delete groundwater monitoring points is made at this time." This is based on 3 samples in 14 years.

The data for the springs was no better. No baseline data existed for either spring. Until I requested the water data in 2004, for the 1st spring there was one monitoring record from 1998. In addition, the location of the monitoring point on the map is a well, not a spring. There was no data for spring 2 until 2000. And the report states the data collected from 2000-2004 are very different from the data that was collected after I requested it. They concluded in the report "Based on the lack of baseline data for comparison, the monitoring data available and actual site conditions: it is clear that the 1101102 operation did not create any adverse conditions at either spring……A request to cease/delete groundwater monitoring at these springs, prior to final bond release, is made at this time."

For the underdrain, samples were only taken in 1995 until I requested the data in 2004. Again, they concluded no adverse effect. Based on the monitoring data, or in this case the lack of data, the conclusion of the entire report is that the mining and reclamation operation had not adversely impacted the hydrologic balance of the permit and adjacent area. I know this a false conclusion, but DMME accepted it.

I have had two other personal experiences that illustrate DMME's lack of responsible oversight/enforcement of mining regulations. I filed a complaint about sediment and water quality issues on my property when it was still under permit. Both companies were issued NOVs. I have no reason to believe the inspector would have done anything to remedy what was going on without my complaint. And the mining companies were granted 6 extensions before they did the work to abate the violations. According to the Administrative Code, extensions cannot be granted because of lack of diligence or intentional delay by the permittee. Yet the only reason I was given for the delay was that the company was busy with other stuff.

The second experience happened just a couple weeks ago when I reported a discharge going into the South Fork of the Pound River from the South Fork Surface Mine. I initially reported the incident at 4 pm and again around 430 pm. There was a massive amount of sediment going into the South Fork of the Pound River, but DMME would not send out an inspector until the following morning. It turned out that Paramont took down a pond spillway to reduce pressure and they were issued a NOV. Once again, without my complaint, I have no reason to believe there would have been any repercussions for the mining company that discharged many tons of sediment into the Pound River in just a couple hours.

I think the DMME has failed and is failing to enforce regulations and protect the environment, especially water quality. Therefore, I think it is very important that they are not a/the lead agency on the development of the TMDLs because the successful development is likely to require more stringent restrictions on the mining industry. The DMME has a corporate memory of serving mining interests. It is not realistic to expect anything different in the process of developing TMDLs.

Comment 2 The derivation of waste loads in the addendum and their relationship to those found in previous draft are unclear.

I was confused when comparing the charts in the addendum with the last draft of the TMDL. The values for total and individual permit TSS WLA's are drastically lower than what is found in a table from the previous draft titled Existing Permitted Sediment Loads. This implies the allocations that go with the current phased TMDL would be lower than what is currently permitted and that changes to permits would be necessary. I was told this is not the case and at the time of the discussion with DMME, thought I understood why. I think there needs to be clarification of this.

Why such a drastic difference between allocations in 2010 draft and 2011 amendment values? If it is because the prior values were based on modelling and current values are based on real monitoring data, does this mean the modeling efforts in the draft are worthless? Or is there something wrong with the data? How many heavy flow events were represented? If it is collected only bimonthly in no relation to rain events (when runoff/erosion would actually occur) is it truly representing what is being contributed? I think the summary of how the WLA values were derived should be expanded. Was each permit assigned a WLA value based on the data of its own discharge? In a table titled Phased Sediment TMDLs from previous draft, several permits are listed as having no associated NPDES sites. How were these individual WLA's calculated? The addendum states "the median of the annual waste loads was then assigned as the mining WLA for the watershed." Is this the median for each NPDES site or for all combined sites? Why was the median chosen? How are values tracked for permits without NPDES sites?

Comment 3 The suggested South Fork TMDL TSS alternative is not attainable/realistic and any alternative should include reductions from active mining.

Three alternatives are presented in the draft and no alternatives call for reductions from permitted sources and all call for 100% reductions from AML. The reasoning behind no reduction from active mining, I was told, is that the mining operations are supposed to be using best available technology. In other words, there is supposedly no room for improvement. I strongly disagree with this. Not only is there room for reductions from improved on the ground operations/engineering design but more vigorous enforcement (which is now lacking) would lead to decreased loads from active mining. There is also the possibility of limiting active surface mining, which should be considered as a viable option.

Reclamation of AML sites is emphasized as a way of reaching TMDL goals. I have some concerns about this. I asked Joey O'Quinn what land cover is classifies as AML and was told it was any land permitted before 1977. It seems this would lead to inflated contributions from the AML land class. A lot of pre1977 mined land has "reclaimed" itself. All alternatives for the South Fork Sediment TMDL include 100% reduction for AML sources. This is unrealistic. The draft TMDL document states the DMLR's efforts to eliminate and reduce pollution from AML will continue in the TMDL watershed. What type of AML remediation have they done in the watershed thus far? Have their efforts been successful?

Third, "reclamation" can lead to greater TSS contributions than initially come from the unreclaimed area. Above the Rat Creek drainage, they have been "reclaiming" a high wall (preSMCRA?) with waste material from coal processing on the other side of mountain. They have been dumping here for over 2 years. The fill slope is very steep, contains a lot of coal fines, is constantly receiving fresh material and has never had any type of cover. This material is very similar to the gob piles that are recognized (even by the mining industry) as being detrimental to water quality. How does this type of thing fit in with BMPs and the assumption that reclamation leads to less pollution?

There is really no discussion/expansion on the three alternatives although the draft states "of the three explored, Alternative 3 is recommended…" How exactly were the 3 Alternatives explored?

Comment 4 There should be a TMDL allocation alternative that includes the option of limiting active surface mining. Based on the phased nature of the TMDL, at what point will DMME stop issuing permits for additional WLAs? "Prior to approval of new NPDES points within a TMDL watershed, the DMME Division of Water Quality staff will conduct a waste load evaluation to determine whether a WLA is available." How would a WLA be available when the TMDL is exceeded?

Comment 5 There needs to be a different approach to water quality monitoring than is presently in place. ES-8 "*South Fork*…….where permitted waste load allocations for sediment are closely monitored and tracked by DMLR, and will serve as the basis for determining existing waste load allocations for new mining permits." It is my understanding the monitoring data is collected by an independent contractor, hired by the mining company and they are required to collect bimonthly samples. Most of the sediment is contributed in pulses, during rain events. There is no reason the samples would be collected during these pulses when the most sediment is being contributed. Sampling methodology needs to account for the increase in TSS and TDS contributions from active, reclaimed, and released permit areas during heavy rain events. Why isn't this done now?

Comment 6 I realize I have limited knowledge of the whole watershed, but from my observations, it appears that active mining and "reclaimed" mine land contribute a bulk of the sediment. P 115 "In the Phillips Creek and South Fork Pound River watersheds, AML and barren land uses are the primary sources of sediment**."** A few sentences later, the draft states that the sediment TMDLs are being developed as phased TMDLs because of uncertainties in contributions of simulated loads from various land uses.

Comment 7 I don't think re-mining is going to restore the aquatic health of the North Fork and/or South Fork of the Pound. P 124 "There is general consensus by the state agencies that an effective way to reduce the majority of excessive TSS loads is through re-mining and reclaiming these AML areas. As the first phase of the North Fork and South Fork Pound River TMDLs is proposed to last two years, this phased TMDL provides a 2 year window to encourage mine operators to re-mine or reclaim AML and to demonstrate the potential of re-mining, by itself, to meet the major sediment reductions from this source which are called for in this TMDL and to restore the aquatic health of the North Fork and South Fork Pound River."

Who are the state agencies that reached this consensus? Re-mining is likely to lead to increased sediment contributions in many AML areas. Is it reasonable to anticipate that re-mining the AML land will restore the water quality of the Pound River?

P132"DMME monitoring data and modeling of local daily precipitation and hydrology have shown the major sediment loading sources in these watersheds to be stormwater runoff from AML and barren lands." **I would like to see the original reference including data sources for this reference.**

Comment 8 There should be a timetable in the TDMDL draft with clearly defined milestones/goals so the progress of the phased TMDL can be assessed.

Preface-2 "DMLR will utilize its existing TMDL processes and software to maintain or decrease existing pollution wasteloads from active mining for sediment (TSS) and total dissolved solids (TDS)." This is listed as an interim action that will be implemented immediately upon approval of the TMDL. Does this refer to the final TMDL, the end of the 2 yr phased TMDL, or the current draft TMDL?

The Monitoring Plan states that the TMDL will be submitted before May 1 2010 and then additional monitoring will be conducted by DMME and DEQ over the next two years. Does this mean that DMME and DEQ have been collecting additional data? If not, why the delay? The Monitoring Plan is lacking specifics and appears to be a plan for developing a monitoring plan.

Comment 9 What will be the role of the recently hired contractor/consulting firm in TMDL development? I am under the impression that the modeling methodology taken by BSE was not a valid approach. I would hope that a modeling approach is not repeated and that more money and effort is devoted to actual groundwork and sampling to develop a clearer picture of source contributions.

Thank you for consideration of my comments.

Jessica Bier

From: Newman, Allen (DEQ)
Sent: Monday, March 28, 2011 12:24 PM
To: O'Quinn, Joey (DMME)
Subject: FW: South fork of Pound River TMDL
FYI--

From: J. Roger Jones [mailto:jjones1@compunet.net]
Sent: Monday, March 28, 2011 11:46 AM
To: Newman, Allen (DEQ)
Subject: South fork of Pound River TMDL

Please include these comments for public notice of TMDL development of South Fork of Pound River:
1.Reference watershed should be representative of mining watershed, not pristine forest watershed; unless additional tiered approached for meeting tiered water criteria is used, as I suggest.
2.Previous underground mining discharges should have been documented in times past; current efforts should be expanded.
3.TMDL limits proposed for TSS and TDS do not sufficiently take in to account stream bed loads of past sediment and any allowance for storm events
4.Exemptions for existing permits should be allowed; such as the Rahall amendment for AML areas
5.Economic analysis should be required for any new regulatory requirements
Thanks

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Only two defining forces have ever offered to die for you, Jesus Christ and the American Soldier.
One died for your soul and the other for your freedom. Remember to Thank them both.

Virginia Mining Issues Group

March 30, 2011

Mr. Allen Newman
Virginia Department of Environmental Quality
Southwest Regional Office
P.O. Box 1688
Abingdon, Virginia 24212

Proposed Modifications to TMDL Reports for
Bull Creek and Pound River

Dear Mr. Newman:

The Virginia Mining Issues Group (VMIG) offers the following comments on DEQ's recent notice "[t]o seek public comment and announce a public meeting on modifications to water quality improvement studies" for Bull Creek and the Pound River. For whatever reason, this notice was not listed as an official public notice on DEQ's website but rather was embedded within an "upcoming public meeting" announcement. We also note that nothing else on DEQ's website made clear that any action had occurred on the TMDLs since the "final public comment periods" ended in February and March 2010, respectively. In short, we question whether the public received proper notice that new modifications were being contemplated or were released for public review.

As you know, VMIG is an *ad hoc* unincorporated association of mining stakeholders located throughout Virginia's coalfields. Our goal is to promote resource protection and water quality restoration through regulatory proceedings that are driven by sound science, as well as cost-effective and practical decision-making.

VMIG has been active in these TMDL proceedings since their inception in 2008. We submitted an initial round of written comments in October 2008, and a second round of written comments in February 2010. We received DEQ's responses to our comments by letter dated April 9, 2010. Between then and now, we have received no further notice or information to bear out the revisions that DEQ committed to make in its responses to our comments, or in parallel meetings between VMIG and DMLR.

The modified TMDL reports that have been posted for public review appear to be unchanged from the versions posted for public review in 2010, with the exception of a 4-page "Amendment" tacked on to the end of each report. The Amendments have the effect of dramatically lowering the wasteload allocations (WLAs) assigned to mining dischargers for both TSS and TDS. For example, in Bull Creek, the TSS WLAs went from 32.5 tons/year to 4.62 tons/year, and the TDS WLAs went from 1,708,803 kg/year to 117,033 kg/year.

To promote meaningful public engagement in these vitally important proceedings, VMIG requested that DEQ make available the full record for the Amendments, including (1) a summary of the proposed changes, (2) the reason for these changes, and (3) the supporting technical record. We also requested a 30-day extension of the comment period. However, all of our requests were denied.

We believe that TMDLs can serve as vital planning tools to help restore impaired waters. But for this to occur, TMDLs must be based on a solid technical foundation, and must be articulated in a way that provides fair notice of regulatory expectations. We respectfully submit that the proposed modifications to the TMDL reports for Bull Creek and the Pound River are infirm in both respects.

1. The Amendments are Fundamentally Inconsistent with a Phased Approach

In developing these TMDLs, DEQ adopted a "phased" approach due to concerns regarding the sufficiency of the available data. Under this phased approach, DEQ committed to conduct additional monitoring and modeling, and thereafter to establish revised TMDLs.

The Amendments present a level of precision and certainty that cannot be supported by the underlying data, models or phased approach. In fact, the Amendments rely on an entirely different set of data and calculations than the original TMDLs.

VMIG generally supports the concept of phased TMDLs to achieve progress in the face of uncertainty. However, we believe that there must be some minimum threshold for data and information, below which there is simply not enough confidence in the regulatory outcome to proceed. In the present TMDL proceedings, DEQ has not made any of its data or calculations available for public review. As a result, interested stakeholders like VMIG cannot independently verify whether DEQ has met the minimum threshold to move forward with the TMDLs. We respectfully submit that DEQ cannot proceed until it has made those data and calculations available.

The Amendments also present individual WLAs for individual point sources, taking the TMDLs to a level of detail beyond any of Virginia's existing coalfield TMDLs. DEQ suggests that these individual WLAs will not be adopted into the WQMP regulation (9 VAC 25-720) or applied directly into NPDES permits. If these are DEQ's "assumptions and requirements," then we urge DEQ to make them explicit in the Amendments themselves. We have recently seen EPA take issue with the assumptions and requirements of earlier TMDLs (characterizing them as implementation components rather than enforceable aspects of the WLAs), and we are concerned that DEQ's failure to be explicit will lead to confusion and conflict in the NPDES permitting process. DEQ can help to avert such confusion and conflict by adding the following language to the Amendments:

> The assumptions and requirements of these individual WLAs are as follows. Existing permitted mining sources will be required to monitor their discharges for TSS and/or TDS (as the case may be in the different impaired segments). However, wasteload allocations for these parameters will not be adopted into the Water Quality Management Planning Regulation or incorporated into individual mining permits.
>
> New mining sources seeking permits after the first phase TMDL is established and approved will be required to monitor their discharges for TSS and/or TDS (as the case may be in the different impaired segments) and offset any additional loading caused by their dischargers.
>
> As part of the second phase TMDL, DMLR will validate or amend, based on all available data and information, its original assumptions about the most probable stressor(s), the water quality target(s) and the modeling output(s). Thereafter, if specified and approved under the second phase TMDL, DMLR may seek to establish individualized wasteload allocations, adopt them into the Water Quality Management Planning Regulation, and then incorporate them into individual mining permits.

2. <u>The Daily Loads were not Calculated Properly</u>

The Amendments present "daily loads" that were calculated by dividing the annual WLAs by 365 days/year. This is flatly inconsistent with applicable EPA guidance.

Congress directed states to establish "total maximum daily loads" but in the thousands of pages of legislative history associated with the Clean Water Act, Congress never explained what it meant by this phrase. For over twenty years, EPA interpreted it to authorize total maximum *non-daily* loads whenever appropriate to implement the applicable water quality standards. EPA's interpretation survived court challenges in 2000 and 2001, and is reflected in many of the tens of thousands of TMDLs in effect today. However, in 2006, a federal appellate court invalidated EPA's interpretation. According to the court, "'daily' means 'daily' and nothing else." <u>Friends of the Earth, Inc. v. EPA</u>, 446 F.3d 140 (D.C. Cir. 2006). In reaching this conclusion, the court rejected EPA's claim that *non-daily* loads may best correlate to the attainment of water quality objectives. According to the court, "all waterbodies can achieve water quality standards if their TMDLs are set low enough -- if all else fails, they can be set to zero -- and the two requirements therefore never conflict with each other."

EPA elected not to seek review of the court's decision and, instead, issued a new national policy styled *Establishing TMDL "Daily" Loads in Light of the Decision by the U.S. Court of Appeals for the D.C. Circuit in Friends of the Earth, Inc. v. EPA et al., No. 05-5015 (April 25, 2006) and Implications for NPDES Permits* (November 15, 2006). In this policy, EPA directs states to express all TMDLs in terms of daily time increments. EPA also offers states an opportunity to "include alternative, non-daily pollutant load expressions in order to facilitate implementation of the applicable water quality standards." In other words, TMDLs *must* include daily loads and *may* include alternate non-daily loads.

After establishing the new policy, EPA issued a series of technical guidance documents on deriving appropriate daily loads, including (1) *Options for the Expression of Daily Loads in TMDLs* (June 2007), and (2) *An Approach for Using Load Duration Curves in the Development of TMDLs* (August 2007). These guidance documents explain different techniques that states may use, including the statistical approach from EPA's Technical Support Document for Water Quality-Based Toxics Control (1991), and a flow variable approach using EPA's load duration curve.

Simply dividing by 365 is not one of these techniques, and in fact was specifically rejected by EPA as unacceptable. As a result, DEQ must revise the daily loads using one of the techniques authorized by EPA. DEQ should also make clear that the daily expression will not be used for permitting purposes but instead will only be used to inform post-TMDL monitoring and tracking.

3. DEQ Needs to Specify Offset Ratios and Options

The TMDLs provide a mechanism for offsets, allowing new mining sources to reclaim existing AML features to, in effect, offset the additional loading from their discharges. We strongly support the use of offsets, which are authorized under both federal and state law. However, we urge DEQ to specify the minimum ratios for allowable offsets. Currently, the TMDL reports simply provide for "positive ratios." This is inadequate to inform affected sources of their obligations/opportunities, and it creates a risk of subjective agency review of offset proposals. Based on our experience, offset ratios of between 1:1 and 2:1 may be appropriate to account for local watershed conditions. Offset ratios above 2:1 appear to be excessive.

We also urge DEQ to acknowledge that reclaiming AML features is simply one (*i.e.*, not the only) offset option. Mine reclamation alone will not be sustainable as the only method to conduct offsets as a mine progresses; therefore, alternate methods will be necessary. Sources should have the freedom to identify and demonstrate load reductions through a variety of means, including, for example, preventive and maintenance activities related to sediment control and other activities based on local watershed conditions and opportunities. In some settings, reductions from other point or nonpoint source contributors may be more feasible, cost-effective and/or environmentally-advantageous than reductions from AML. DEQ has no legal, practical or technical basis to preclude such other options.

4. DEQ's Stressor Analysis is Incomplete

In a welcome departure from past practice, DEQ considered at least one non-pollutant stressor (i.e., hydrologic modification) in its benthic stressor analysis and, in fact, concluded that this stressor was a primary cause of impairment in one of the contributing creeks. However, DEQ failed to consider any other non-pollutant stressors, and also failed to account for hydrologic modification, once identified, in any meaningful way. Instead, DEQ simply concluded that "since 'hydrologic modification' is not classified as a 'pollutant' by USEPA in the Clean Water regulations, a TMDL will not be developed for this stressor." DEQ's conclusion completely misses the mark.

Existing federal guidance compels states to <u>fully</u> <u>assess</u> the condition of their waters. Only then can a state make an informed decision about whether to embark on a TMDL, or alternatively, pursue some other type of control strategy.

DEQ seems to think that it is limited by Section 303(d) of the Clean Water Act, which compels states to establish TMDLs for <u>pollutants</u> causing impairment. But the statute goes on to say that states must establish TMDLs "at a level necessary to implement the applicable water quality standards." If a state cannot meet this standard because non-pollutant stressors are not only dominant, but the primary cause, then no amount of attention on pollutants will meet the statutory mandate. Attainment of TMDL expectations needs to be practicable and achievable.

For the TMDL process to be effective, DEQ must start with a stressor analysis that considers <u>all</u> contributors to the impairment, whether pollutant or non-pollutant. If the dominant stressors are pollutants, then the TMDL process should continue. On the other hand, if the dominant stressors are non-pollutants, then the TMDL will be ineffectual at attaining standards. In this scenario, some other type of control strategy (e.g., a use attainability analysis) must be pursued.

We have repeatedly made this point, and DEQ has repeatedly ignored it. Recently, EPA authored a report about one of the creeks subject to one of DEQ's existing TMDLs. "*Evaluating Appropriate Existing and Designated Uses of Straight Creek (Lee County, VA) Using Current Macroinvertebrate, Habitat and Water Quality Data*" by Margaret Passmore and Gregory Pond (2009). In that report, EPA admitted that non-pollutant stressors, like habitat modification, may be causing the impairment. If this is true, then it makes absolutely no sense to ignore such stressors until after a TMDL is in place and pollutant reductions are imposed on regulated sources. Inaccurately or incompletely identifying stressors in this manner will result in either wasted resources caused by chasing a problem that does not exist, or unacceptable environmental consequences caused by ignoring a problem that in fact does exist. Either way, DEQ's practice of ignoring non-pollutant stressors cannot stand.

5. <u>DEQ's Interpretation of the General Standard in the TMDLs is Unlawful</u>

DEQ purports to use a reference approach to interpret the applicable water quality standards and derive water quality targets for TSS and TDS in the TMDLs. But doing so is a *de facto* change in standards subject to Section 303(c) of the Clean Water Act. The statute provides a mandatory process for the review and revision of water quality standards by states and, where necessary, EPA.

In this case, neither Virginia nor EPA established numeric criteria or a numeric translator procedure for the general standard at issue in the TMDLs, or for the particular pollutant parameters identified for reduction (TSS and TDS). Such criteria or procedures are clearly needed for the TMDL process to be effective, but DEQ cannot simply adopt them in an *ad hoc* manner. Rather, DEQ's only recourse is to initiate a rulemaking under Section 303(c). By avoiding this mandatory process, DEQ has in effect denied interested stakeholders any meaningful opportunity to review or contest DEQ's decision. DEQ has also undermined its own ability to demonstrate (as it must) that the TMDLs are "necessary" to implement the applicable standards (as compared to "more than necessary" or "less than necessary" based on inherent differences between the reference and target creeks).

The reference approach is simply too imprecise, and too subjective, to meet DEQ's core statutory obligations. To underscore this point, we note that the creek selected as a reference for TDS in Bull Creek was seven times larger (Lower Dismal Creek 22,069 ha; Bull Creek 3,129 ha), a differential that was not adjusted or addressed in any meaningful way. Moreover, both Burns Creek and Bailey's Trace were eliminated as possible reference watersheds due to their size. How can these decisions be squared as anything other than imprecise and subjective?[1]

6. Modeling Issues Need to be Addressed

DEQ admits that model refinements will be needed before embarking on the second phase TMDLs. However, even the first phase TMDLs demand more. At a minimum, DEQ needs to provide: (1) a quality assurance plan; (2) a written statement of modeling objectives that includes the variables of concern, the stressors driving the variables, appropriate temporal and spatial scales, and the necessary degree of model accuracy and precision; (3) data quality objectives and a statement of the acceptable range of uncertainty; (4) calibration reports; and (5) sensitivity and uncertainty analyses. *See, e.g.*, EPA Guidance on the Development, Evaluation and Application of Environmental Models (March 2009).

We are concerned that defects in the existing modeling analyses may overstate the impacts from some land uses and understate the impacts from other land uses. For example, the run-off curve numbers used for disturbed forests in the models appear to be grossly inaccurate. These types of inaccuracies undermine the TMDL calculations, the allocations to different sources, and DEQ's expectations regarding reductions and reasonable assurance.

[1] We note, as well, that the Amendments would apply DEQ's *ad hoc* in-stream TDS target as an instantaneous limit. However, the reference watershed approach was never designed to be used in this manner. Rather, if there are appropriate and sufficient data, then the reference concentration is supposed to be used to derive a target loading at the outlet of the impaired water -- not at each point source discharge. Moreover, in a recent Virginia Tech study, it was shown that TDS demonstrates significant temporal variability, which cuts against using any kind of instantaneous limit.

We submit that it would be premature for DEQ to proceed with even the first phase TMDLs until these modeling issues are addressed.

7. The TMDL Amendments Must be Submitted to the State Water Control Board

These particular TMDLs were scheduled to be established by May 1, 2010, in accordance with the Consent Decree and Settlement Agreement in American Canoe Association v. EPA, June 11, 1999. In an effort to meet this schedule, DEQ bypassed Board review and submitted the TMDLs directly to EPA for approval. EPA has not officially acted on this submittal. Instead, we understand that the Agency offered informal comments that prompted the Amendments at issue now. Those comments have not been made available for public review.

We have grave concerns that the process employed here deprives interested stakeholders of their rights before the State Water Control Board. From time to time in the past, DEQ has attempted to bypass Board review in the face of objection from interested stakeholders. In each case, the Board has provided stern and unequivocal instruction to DEQ never to do so again. The reason for this instruction is simple:

> For the public process to be meaningful, the Board must have an opportunity to review and approve TMDLs before they are submitted to EPA. Following such review and approval, affected members of the regulated community -- including dischargers regulated under Va. Code § 62.1-44.16 -- must be afforded an opportunity for a hearing under Va. Code § 62.1-44.25. Absent that opportunity, DEQ could inadvertently bypass the public, administrative and judicial review processes by developing and submitting a TMDL to EPA without formal Board approval and, later, adopting the EPA-approved TMDL under a claimed exemption in the State Administrative Process Act.

We urge DEQ to take the Board's instruction to heart and submit the TMDL Amendments first to the Board, then to EPA.

We respectfully request specific responses to the specific concerns raised in this letter before DEQ moves forward with these TMDL proceedings. Needless to say, we would be pleased to meet with you to discuss our comments in more detail, or to provide any additional information that may facilitate your efforts to derive a legally defensible and appropriate TMDLs.

Please feel free to contact me (bsmith@hunton.com / 804-787-8086) with questions.

Sincerely,

Brooks M. Smith

Brooks M. Smith
Common Counsel

cc: Members of the Virginia Mining Issues Group
Mr. Joey O'Quinn, DMLR

From: Yagow, Gene [eyagow@exchange.vt.edu]
Sent: Friday, March 04, 2011 2:55 PM
To: O'Quinn, Joey (DMME)
Cc: Newman, Allen (DEQ); Smith, Michael F. (DMME); Benham, Brian; Kline, Karen
Subject: Comments on the February 2011 Amendments to the Bull Creek and NF/SF Pound River TMDLs

Joey,

After reviewing the amendments, I have the following comments on the amendment that I hope you will use to strengthen your submission to EPA.

Different procedures were used for the derivation of the TSS and the TDS TMDLs. I think that the justification to EPA may be stronger if the same procedure is used for both. That being said, I have suggestions for alternative calculations for each.

- The current calculation for TSS is really a calculation of the "existing" load, which may differ considerably from some protective long-term average load (the TMDL). I also think that using the "existing" load is inequitable to the mining permit holders as it penalizes those that are doing a good job by assigning them a lower WLA and gives a relatively more generous WLA to those that are not controlling their sediment. I would suggest applying the historical flow time-series to the average daily permitted TSS concentration (35 mg/L), in order to be protective of the maximum daily permitted TSS concentration of 70 mg/L (never to be exceeded). Also be aware that if you use the current calculations, using an "average", rather than a "maximum", annual load based on the historical time-series means that 50% of the time, the permittees will be exceeding their WLAs due to annual weather variations.
- The TDS TMDL calculated by your procedure results in a considerably larger value than in the simulated TMDL which considered 369 mg/L as a "maximum" value, never to be exceeded, rather than an average value, as in your calculations. I would therefore recommend using the same historical flow time-series and apply it to some average TDS concentration, which would then be assumed to be protective of the identified maximum allowable TDS concentration (369 mg/L) for calculating the surface runoff contribution to the respective WLAs. The average TDS concentration could be arrived at from the average in the simulated time series (which for Scenario 9 was 188 mg/L) or assumed to be half of the maximum (184.5 mg/L), similar to the ratio of the average daily and maximum TSS values. I would then recommend applying this average daily TDS concentration, to the historical flow time-series at the watershed outlet and applying the individual permit outfall flow time-series to the average concentration for the individual WLAs. (This is a similar procedure to what I think you used, except for using an average daily, rather than a maximum daily, TDS concentration).

Why was a coefficient of variation (COV) "assumed", rather than "calculated", according to EPA guidance? It is not clear how the daily values were calculated from the annual values. How was the COV used in this process? If the EPA guidance was used to interpolate a multiplication factor, that should be clearly stated and the guidance cited to strengthen the justification.

Were the responses to the questions from EPA on June 23, 2010 also incorporated into the revised report? I can't locate the exact emails where I sent my responses back to you, but I know it was during the week following your June 23, 2010 email. I had incorporated all of the responses into a June 28, 2010 revision to the Draft reports for both Bull Creek and NF/SF Pound, but I couldn't find any record of having transmitted those revisions to you. I have put them both at the following ftp site, in case you want to incorporate those revisions that would not have been affected by your proposed amendments:

ftp://bsesrv214.bse.vt.edu/Yagow/BullCreek/BLC-BenthicTMDLReport_062810.doc
and
ftp://bsesrv214.bse.vt.edu/Yagow/PoundRiver/NFSF_Pound_BenthicTMDLReport_062810.doc

The calculations for the TDS TMDL imply that mining areas only contribute TDS via surface runoff, whereas TDS in groundwater is clearly impacted by mining activities. While I realize the difficulty this may present in calculating a load from each permit, if this source is not acknowledged, there is no way that needed TDS reductions can ever be addressed. It is a dilemma. By recognizing groundwater as a mining source, it means that the WLA for each permit would be increased by the portion of load attributed to groundwater and that some mechanism must be developed to quantify this contribution. By ignoring this source, the WLAs will be a much smaller load (and therefore, a smaller target), but their existing loads will also be tremendously underestimated, in my opinion, so that control measures needed to reduce groundwater contributions won't even be considered.

I hope these comments will be useful in the processing of your amended submittal to EPA.

…Gene

Gene Yagow
Senior Research Scientist
Biological Systems Engineering Dept.
Virginia Tech
306 Seitz Hall (0303)
Blacksburg, VA 24061
Phone: 540-231-2538
FAX: 540-231-3199

RESPONSE LETTERS TO PUBLIC COMMENTS

COMMONWEALTH of VIRGINIA

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L. Preston Bryant, Jr.
Secretary of Natural Resources

David K. Paylor
Director

Dallas R. Sizemore
Regional Director

April 11, 2011

Ms. Jessica Bier
9707 Greywell Road
Pound, Virginia 24279

Dear Ms. Bier:

Thank you very much for your comments regarding the addendum to the Draft North Fork and South Fork Pound River Phased Total Maximum Daily Load (TMDL) Report. Your comments have been reviewed and are being considered.

As you are aware, Virginia's Departments of Environmental Quality (VADEQ), Mines, Minerals, and Energy (VADMME), and Conservation and Recreation (VADCR) prepared and submitted four phased coalfield TMDL reports to EPA Region III during April 2010. The VADMME is the agency that has led the technical development of the phased portion of the TMDLs since they are the agency that regulates coal mining in Virginia. EPA has approved two of the four reports (Levisa Fork River and Powell River) and is finishing their review of the final two (Bull Creek and NF/SF Pound River). EPA's review has a May 1, 2011 deadline. Once all four phased reports are approved by EPA, then VADEQ, VADMME, and VADCR will begin the second phase of TMDL development. During the second phase, planned for a two year period following EPA approval, stakeholders will have opportunity to actively participate with the state agencies in the collection of supplemental data and the preparation of the anticipated second phase revisions to the initial TMDL reports. In fact, we are proposing to schedule the public participation early in the process. During this public participation we propose to discuss the TMDL development and seek input from stakeholders on the TMDL development plans, including additional monitoring needed to develop the TMDL. We are proposing to consider all stakeholder comments during the phased TMDL process.

To ensure that your comments, as well as those of other stakeholders, are considered and addressed, the comments will be attached to the first phase report addendum(s) and the following language will be included in the preface of the report(s); *Written public comments received on* *the addendum to the report are attached and will be considered and addressed during the second phase of TMDL development.*

We are looking forward to working with you on the phased TMDL.

Sincerely,

Allen Newman, PE
Water Permit Manager

cc: Mr. Joey O'Quinn, DMME

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L. Preston Bryant, Jr.
Secretary of Natural Resources

David K. Paylor
Director

Dallas R. Sizemore
Regional Director

April 11, 2011

Mr. Roger Jones
Red River Coal Company
Post Office Box 668
Norton, Virginia 24273

Mr. Jones:

Thank you very much for your comments regarding the addendums to the Draft North Fork/South Fork Pound River Phased Total Maximum Daily Load (TMDL) Reports. Your comments have been reviewed and are being considered.

As you are aware, Virginia's Departments of Environmental Quality (VADEQ), Mines, Minerals, and Energy (VADMME), and Conservation and Recreation (VADCR) prepared and submitted four phased coalfield TMDL reports to EPA Region III during April 2010. The VADMME is the agency that has led the technical development of the phased portion of the TMDLs since they are the agency that regulates coal mining in Virginia. EPA has approved two of the four reports (Levisa Fork River and Powell River) and is finishing their review of the final two (Bull Creek and NF/SF Pound River). EPA's review has a May 1, 2011 deadline. Once all four phased reports are approved by EPA, then VADEQ, VADMME, and VADCR will begin the second phase of TMDL development. During the second phase, planned for a two year period following EPA approval, stakeholders will have opportunity to actively participate with the state agencies in the collection of supplemental data and the preparation of the anticipated second phase revisions to the initial TMDL reports. In fact, we are proposing to schedule the public participation early in the process. During this public participation we propose to discuss the TMDL development and seek input from stakeholders on the TMDL development plans, including additional monitoring needed to develop the TMDL. We are proposing to consider all stakeholder comments during the phased TMDL process.

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We are looking forward to working with you on the phased TMDLs.

Sincerely,

Allen Newman, PE
Water Permit Manager

cc: Mr. Joey O'Quinn, DMME

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April 11, 2011

Dr. Gene Yagow
Virginia Tech
306 Seitz Hall
Blacksburg, VA 24061

Dr. Yagow:

Thank you very much for your comments regarding the addendums to the Draft North Fork/South Fork Pound River and Bull Creek Phased Total Maximum Daily Load (TMDL) Reports. Your comments have been reviewed and are being considered.

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We are looking forward to working with you on these phased TMDLs.

Sincerely,

Allen Newman, PE
Water Permit Manager

cc: Mr. Joey O'Quinn

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David K. Paylor
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Dallas R. Sizemore
Regional Director

April 11, 2011

Mr. Brooks Smith
Riverfront Plaza, East Tower
951 East Byrd Street
Richmond, Virginia 23219-4074

Dear Mr. Smith:

Thank you very much for your comments regarding the addendums to the Draft North Fork/South Fork Pound River and Bull Creek Phased Total Maximum Daily Load (TMDL) Reports. Your comments have been reviewed and are being considered.

As you are aware, Virginia's Departments of Environmental Quality (VADEQ), Mines, Minerals, and Energy (VADMME), and Conservation and Recreation (VADCR) prepared and submitted four phased coalfield TMDL reports to EPA Region III during April 2010. The VADMME is the agency that has led the technical development of the phased portion of the TMDLs since they are the agency that regulates coal mining in Virginia. EPA has approved two of the four reports (Levisa Fork River and Powell River) and is finishing their review of the final two (Bull Creek and NF/SF Pound River). EPA's review has a May 1, 2011 deadline. The Public Participation Guidance allows DEQ to submit to EPA prior to Board action if timing to meet EPA deadlines is an issue. DEQ will make an effort to inform the Board of this action and all public comments received will be included as part of the EPA submittal package. Once all four phased reports are approved by EPA, then VADEQ, VADMME, and VADCR will begin the second phase of TMDL development. During the second phase, planned for a two year period following EPA approval, stakeholders will have opportunity to actively participate with the state agencies in the collection of supplemental data and the preparation of the anticipated second phase revisions to the initial TMDL reports. In fact, we are proposing to schedule the public participation early in the process. During this public participation we propose to discuss the TMDL development and seek input from stakeholders on the TMDL development plans, including additional monitoring needed to develop the TMDL. We are proposing to consider all stakeholder comments during the phased TMDL process. Individual permit WLAs developed in the Bull and Pound TMDL reports are not inconsistent with past mining TMDL development. DEQ's approach to Board approval and adoption of the WLAs into the Water Quality

Management Planning Regulation, for phased TMDLs and those that are known to contain significant data gaps that may drive modification or amendment, is to defer Board action until the revisions are more certain. EPA has historically approved Virginia TMDLs utilizing this method of daily load calculation.

To ensure that your comments, as well as those of other stakeholders, are considered and addressed, the comments will be attached to the first phase report addendum(s) and the following language will be included in the preface of the report(s); *Written public comments received on the addendum to the report are attached and will be considered and addressed during the second phase of TMDL development.*

We are looking forward to working with the Virginia Mining Issues Group in the development of these phased TMDLs.

Sincerely,

Allen Newman, PE
Water Permit Manager

cc: Mr. Joey O'Quinn, DMME